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HUGO GERNSBACK, Editor-in-chief

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ge 40

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Radio-Electronics

MAY 1964 VOL. XXXV No. 5

Over 55 Years of Electronic Publishing

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AUDIO-HIGH FIDELITY-STEREO

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Radio-Electronics is indexed in *Applied Science & Technology Index (Formerly Industrial Arts Index).*

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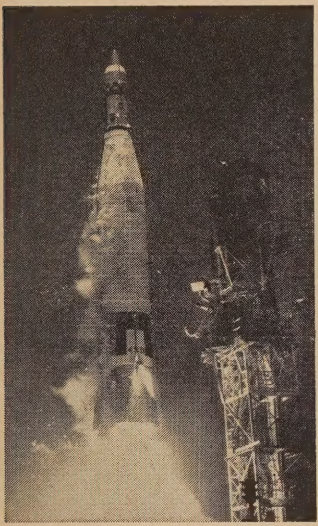

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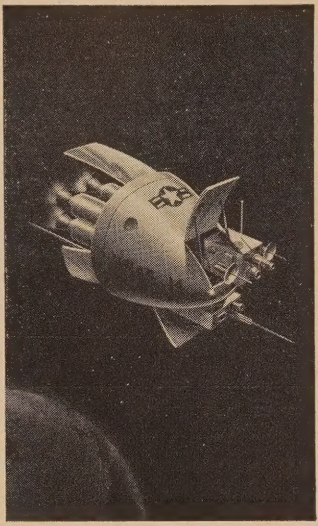

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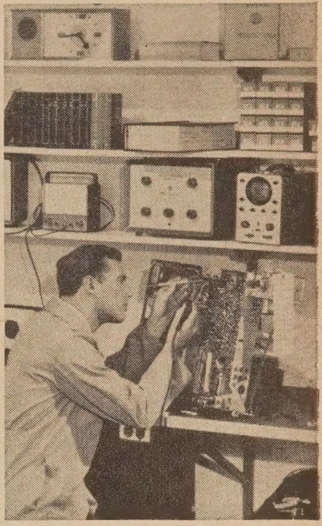

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NEWS BRIEFS

FCC Goes Electronic

The FCC issued its first computer-processed license on Feb. 12. The first electronically handled license was for a Class-D Citizens Band station, KKA-0001, issued to David W. Berry of Caratunk, Me.

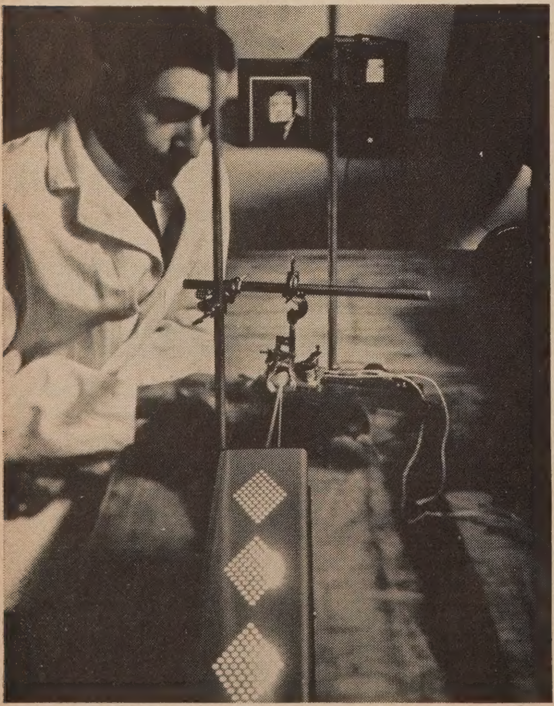
Amateur licenses were next in line for electronic processing and printing. Within the next year or two, all applications in marine aviation, public safety, industrial and land transportation services will be handled by computer. At the same time, other information will also be processed electronically, such as computation of radiation and service contour patterns, and checking of antenna heights for safety.

The system, a UNIVAC III, cost a little more than $1,000,000. Its installation was approved in 1962.

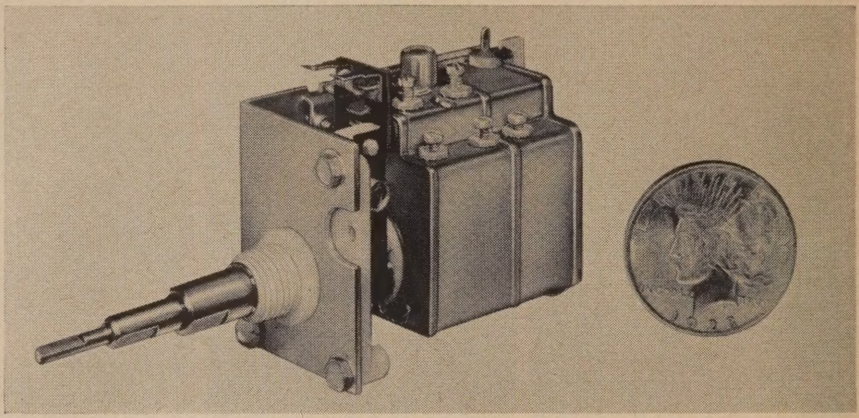
Laser Provides Light For TV Camera

What is believed to be the first use of lasers in a TV camera system is reported from General Precision Laboratories' Aerospace Group at Pleasantville, N.Y. The laser was used as a flying-spot scanner. A phototube picked up the varying beam of light as the picture was scanned, and the image was displayed on an oscilloscope.

General Precision scientists point out that the laser beam is an exceptionally efficient scanner, because the beam is monochromatic and its intensity is very high. They believe that there are numerous applications of the laser along this line: television where normal light is inadequate; photography in deep space, as of the dark side of the moon or planets; detecting objects in the dark.



The laser (foreground) is scanning the portrait at rear center and the image is displayed on the scope just to the right of it.



Now—Detent Tuner For Uhf TV

The industry's first detented uhf television tuner, featuring a positive click sound and touch for each of the 70 ultra-high-frequency channels, has been announced by Oak Manufacturing Co., of Crystal Lake, Ill.

The new tuner, they say, is the smallest available, measuring 2½ x 1¾ x 1⅛ inches. It uses 270° to tune all 70 channels and is designed for continuous two-way rotating action in either direction (like the conventional vhf tuner rather than like earlier uhf tuners which had to be reversed at the end of rotation). That is, the Oak tuner tunes direct from channel 83 to channel 14, instead of having to go backward from the high to the low end.

New Vortex Sound Theory Explains Humming Wires

Eddies (vortices) in the airstream rather than the vibration of solid objects are responsible for many types of sound, such as the singing of wind around a telephone wire or the howling of a jet engine.

This theory was supported by Dr. Alan Powell of the Aerosonics Laboratory, University of California, Los Angeles, and appeared in the January issue of the *Journal of the Acoustical Society of America.*

According to Dr. Powell's theory, the sounds are caused by the formation of eddies in the airflow or the breaking up of large eddies into

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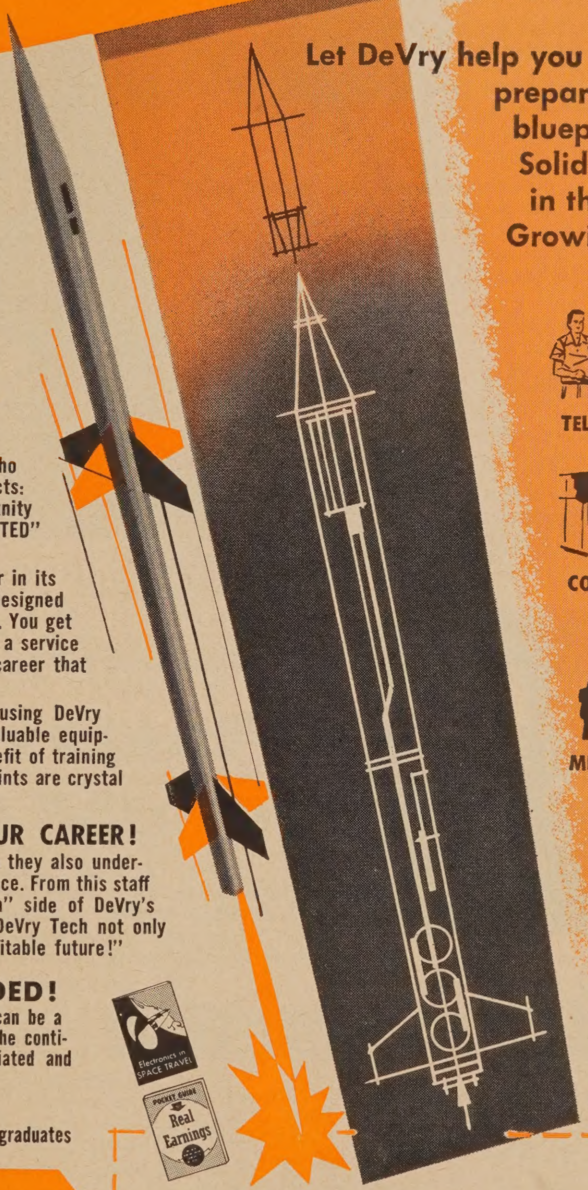

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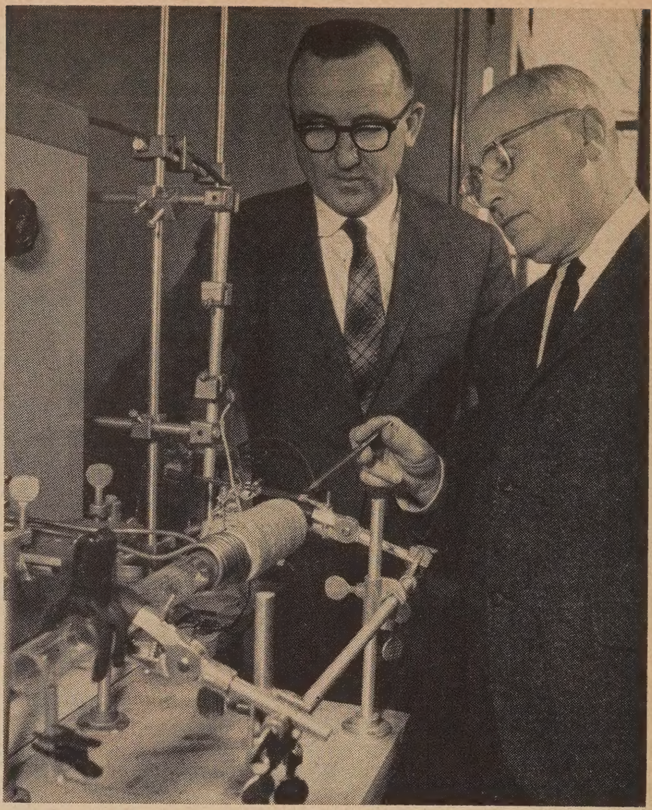

Equipment used to produce crystals. The quartz tube wrapped with an rf inductio heating coil contains a silicon crystal on which a small particle of gold reacts wi silicon to form a liquid droplet. A vapor of silicon tetrachloride and hydrogen passed over the sample in the tube, silicon atoms enter the liquid, supersaturate and deposit themselves at the interface between the droplet and the substrat Scientists Richard S. Wagner and William C. Ellis inspect the process.

smaller ones. "When the fluid is compressible," says Dr. Powell, "the very action that causes the formation of vortices, or eddies, simultaneously gives rise to the sound radiation." The sound of wind in the eaves of a house, of a jet engine and similar sounds were examples given where there was no movable mechanical part, the sound being produced by the airflow itself.

One comforting note by Dr. Powell: because the eddies in the air caused by a jet engine rotate in opposite directions on each side of the jet, they very nearly cancel out the sound of each other, so the total is only a small fraction of the whole amount of sound made by the engine. Even then, the power of the sound is enormous and can be measured in thousands of watts.

Crystal Growth Secret Found by Bell Scientists

Two metallurgists at Bell Telephone Laboratories, R. S. Wagner and W. C. Ellis, have discovered the fundamental mechanism of crystal growth. Called the vapor–liquid–solid (VLS) mechanism, it occurs when a droplet composed of a saturated solution of a crystalline material and an impurity receives atoms from a vapor, and then deposits these atoms at the interface between the droplet and a crystalline substrate.

To grow whiskers or rodlil crystals of silicon by the VLS mec anism, small particles of gold a placed on a silicon substrate cryst and heated in a furnace to form dro lets of gold-silicon alloy saturate with silicon. Then a vapor of silicc tetrachloride and hydrogen, whic can react to produce elemental si con, is passed over the droplets. Tl droplets receive silicon atoms fro the vapor or, perhaps more likel serve as a catalyst for the reactio Silicon atoms entering the liqu supersaturate it, causing silicon ar minute quantities of gold to free out (solidify) on the crystal su strate. As this process continues, th alloy droplet becomes displaced fro the substrate crystal and rides ato the growing whisker.

The discovery of the VLS mec anism stems from research on th growth of microscopic hairlike fil ments, or "whiskers", eight-milliont of an inch thick, that mysteriousl grow on certain metals.

Armed Forces Day Is May 1

The traditional Armed Forc message from the Secretary of D fense will be transmitted May 16 11:00 pm, EST (0300 GMT M 17). Ten MARS frequencies rangir from 3.347 to 14.045 mc are use

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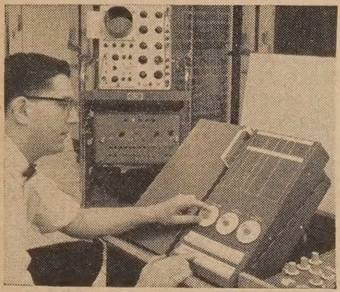

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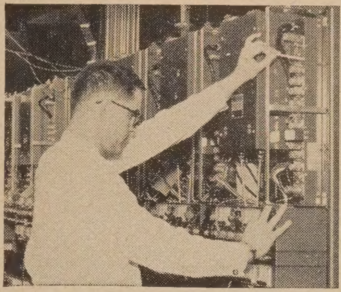

Mobile Radio, Microwave and 2nd Class FCC Preparation are just a few of the topics covered in this "compact" program . . . Carrier Telephony too, if you so desire.

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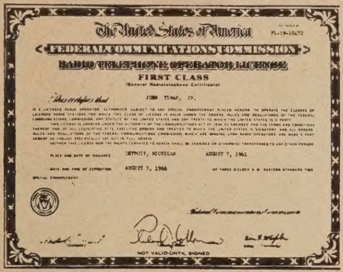

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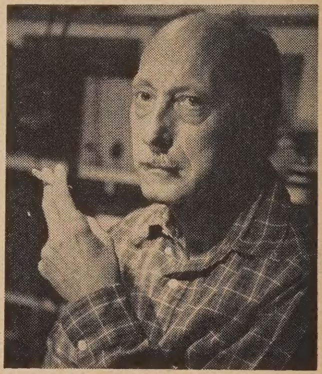
Radioteletypewriter receiving contest and cross-band transmissions between U.S. military stations working outside the amateur bands and hams will also feature the day—the only time in the year that amateurs may legally work cross-band with the designated military stations.

Joe Marshall Dead

Joseph Marshall (Krechniak) died Feb. 23 at the age of 55. He had suffered a heart attack a month earlier, but had apparently recovered.

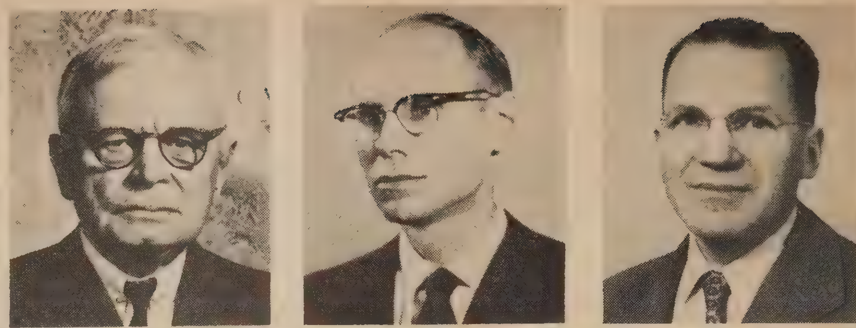


Joe Marshall's excellent writing style stemmed from his experience as a fiction writer. He had written short stories for 25 years for the *Saturday Evening Post* and other magazines. He contributed a few radio articles to QST in the 30's and was a steady contributor to this magazine since June 1950.

A few of his articles were bylined Joseph Krech, the first part of his legal name. He was also a frequent audio contributor to other magazines, and the author of books on audio and high fidelity.

Eleven Award Winners Announced by IEEE

The Medal of Honor of the Institute of Electrical & Electronics Engineers "for an exceptional contribution to the fields of science and technology..." was awarded to Harold A. Wheeler of Wheeler Labs, Great Neck, N.Y., "for his analyses of the fundamental limitations on the resolution in television systems and on wide-band amplifiers, and for basic contributions to the theory and development of antennas, microwave



IEEE Founders Award was given to A. G. L. McNaughton (left) of Ottawa, Canada. John R. Pierce (center), director of research communications principles, Bell Labs, receiver of the Edison Medal. The IEEE Medal of Honor was awarded to H. A. Wheeler (right), Wheeler Laboratories, Great Neck, N. Y.

elements, circuits and receivers."

The annual Edison Medal, given for technical achievements extending over a period of years, goes to John R. Pierce of Bell Labs "for pioneer work and leadership in satellite communications and . . . contributions to electron optics, traveling-wave theories and the control of noise in electron streams."

The Founders Award, given annually for outstanding service to the IEEE and the profession, goes to George McNaughton of Ottawa, Canada.

The Lamme Medal was awarded to Loyal V. Bewley, General Electric Co., Schenectady, N.Y.; the Education Medal to B. Richard Teare, Jr. of Carnegie Institute of Technology, Pittsburgh; the Morris Liebmann Memorial Prize to Arthur L. Schawlow, Physics Department, Stanford University, Calif., and the Harry Diamond Memorial Prize to James R. Wait, National Bureau of Standards, Boulder, Colo. Four prizes for scientific papers were also issued.

CALENDAR OF EVENTS

1964 Electronic Components Conference, May 5–7; Marriot Twin Bridges Motor Hotel, Washington, D. C.

16th Annual Aerospace Electronics Conference, May 11–13; Biltmore Hotel, Dayton, Ohio.

1964 May Electronic Parts Distributors Show, May 18–20; Conrad Hilton Hotel, Chicago, Ill.

International Instruments, Electronics & Automation Exhibition, May 25–30; Olympia, London, England.

10th Annual Radar Symposium, May 26–28; Fort Monmouth, N. J.

International Symposium on Global Communications (GLOBECOM VI), June 2–4; University of Pennsylvania and Sheraton Hotel, Philadelphia, Pa.

National Telemetering Conference, June 2–4; Biltmore Hotel, Los Angeles, Calif.

Symposium on Quasi-Optics, June 8–10; Statler-Hilton Hotel, New York, N. Y.

6th National Symposium on Electromagnetic Compatibility, June 9–11; Los Angeles, Calif.

Chicago Spring Conference on Broadcast & TV Receivers, June 15–16; O'Hare Inn, Des Plaines, Ill.

1964 Conference on Precision Electromagnetic Measurements, June 16–18; National Bureau of Standards, Boulder, Colo.

International Unit System Adopted by NBS

The National Bureau of Standards has adopted the International System of Units and will employ it in all publications, except where their use might be confusing to the recipients. Standards and measuring devices normally valued in inches, pounds and gallons will continue to be calibrated in these units. Most of the units are already in use in the United States.

One unit that will be a definite change is that for frequency. The *hertz* (symbol Hz), used for decades in continental Europe as the equivalent of our "cycles per second," has become the standard for US use also. A frequency of 1 megacycle per second (1 mc) will be 1 megahertz (1 MHz).

Voice of America Broadcasts Space News

Latest data on new satellite launchings (including orbit information and radio frequencies) and up-to-the-minute revised statistics on satellites in orbit is being broadcast 6 days a week. The program is conducted by the Voice of America and the National Academy of Sciences.

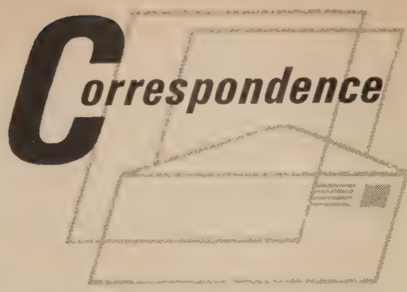
Programs are in English and are called SPACEWARN broadcasts. They will continue to May 2, 1964, from several VOA stations on frequencies from 6 to 11 mc. Program times are 0330–0335 GMT Tuesday–Sunday and 10:30–10:35 PM EST Monday–Saturday.

The Voice of America *Radio Amateurs' Notebook* is being continued from 0730 to 0745 and 0845 to 0900 Sundays on 12 frequencies from 5.995 to 17.735 mc.

New Laser "Rifle" Not a Death Weapon

The laser "rifle," recently reported in the newspapers as having been delivered to Frankford Arsenal in Philadelphia by Maser Optics of Boston, is *not* a lethal or incendiary weapon, according to spokesmen at the arsenal. It is intended, it is stated, as a research instrument, for ranging (presumably in the radar sense) and other purposes.

A gunlike laser was, incidentally, described and illustrated in RADIO-ELECTRONICS in January 1963 (page 31.) END



Correspondence

Multiplex Video Improved

Dear Editor:

Your editorial "Multiplex Video" (March 1964, page 23) was interesting and, as these things should do, started up the thinking process.

I'd like to put in a little improvement that would make the whole thing possible at essentially no cost to the viewer!

I say that no auxiliary picture tubes are needed at all. The main picture is simply shrunk down a little and the extra channel pictures are simply inserted around one side and the top of the picture, *by the station* showing the main picture. TV stations would cable their programs to each other, and each would insert the reduced extra pictures around the edge of its own program picture. This kind of thing is being done right now by studio special-effects generators.

The viewer could have a size control to cut out the extraneous material if he wanted to. If the sound could be multiplexed onto the picture, the viewer could get the auxiliary station's audio by aiming some kind of photoelectric gadget at the particular picture "insert" he was interested in. Of course, this would be an accessory and so the basic cost of the TV might be almost normal.

Individual stations themselves could use the picture-insert technique for stock reports, show previews, news, weather, foreign-language subtitles, etc. Extra audio sent this way could be used for stereo effects, other languages, background music or other sensory effects.

PETER LEFFERTS
President
Electro Audio Research Laboratories
Hopewell, N.J.

[Sounds quite reasonable electronically. But who is going to sell our broadcasters, who will refer to each other only as "another network," on the idea of running their competitors' programs as frames for their own images?—*Editor*]

Wants Oscillator-Freqmeter Kits for Organ Service

Dear Editor:

Mr. Kirk's fine article in the January issue of RADIO-ELECTRONICS ("Electronic Organ Service Bench") was very interesting to me.

I have been working with electronic organs for the past 7 years, and this is the first time I have ever found anyone who is actually trying to help in this field.

I wish he would make up kits for the audio generator and frequency meter, along with complete instructions. They would sell like hotcakes. We are told that about 1,000,000 electronic organs have been sold, and that 2,000,000 more are expected to be sold in the next year or two. We know that organs do require attention, since they are made by man. Mr. Kirk's article is the first of its kind I have read. Seems most other electronics men confine their thinking to radio and TV.

L. C. UMBREIT
Berlin, Wis.

Finds Organ Service Story Misleading

Dear Editor:

The article in the January (1964) issue by Jim Kirk ("Electronic Organ Service Bench") is very misleading!

I am an electronic organ field service engineer. This is my tenth year in this field, so I can speak with some authority.

First of all, if you haven't grown up with the organ field, the best background is industrial electronics or computers, not TV or radio. Most times, TV and radio men make poor organ men.

Next, I have found that full-time organ service men do superior work and charge much less than part-time organ men. It take a full-time man to be really proficient.

Mr. Kirk never mentioned transistors. All organ manufacturers use them. In the near future, there will be no tube organs.

Tuning *can* be done by ear. If a piano can be tuned that way, so can an organ. The Bryant School in Sacramento, Calif., has an excellent organ course that teaches tuning by ear.

True, the Conn Stroboconn costs about $700 and is not very portable, but they also have a Strobotuner for about $125 that *is* portable.

Concerning having a tape recording of a Hammond organ's fundamental pitches: the Hammond is not a tempered-scale organ, and therefore is not exactly in tune with most other instruments.

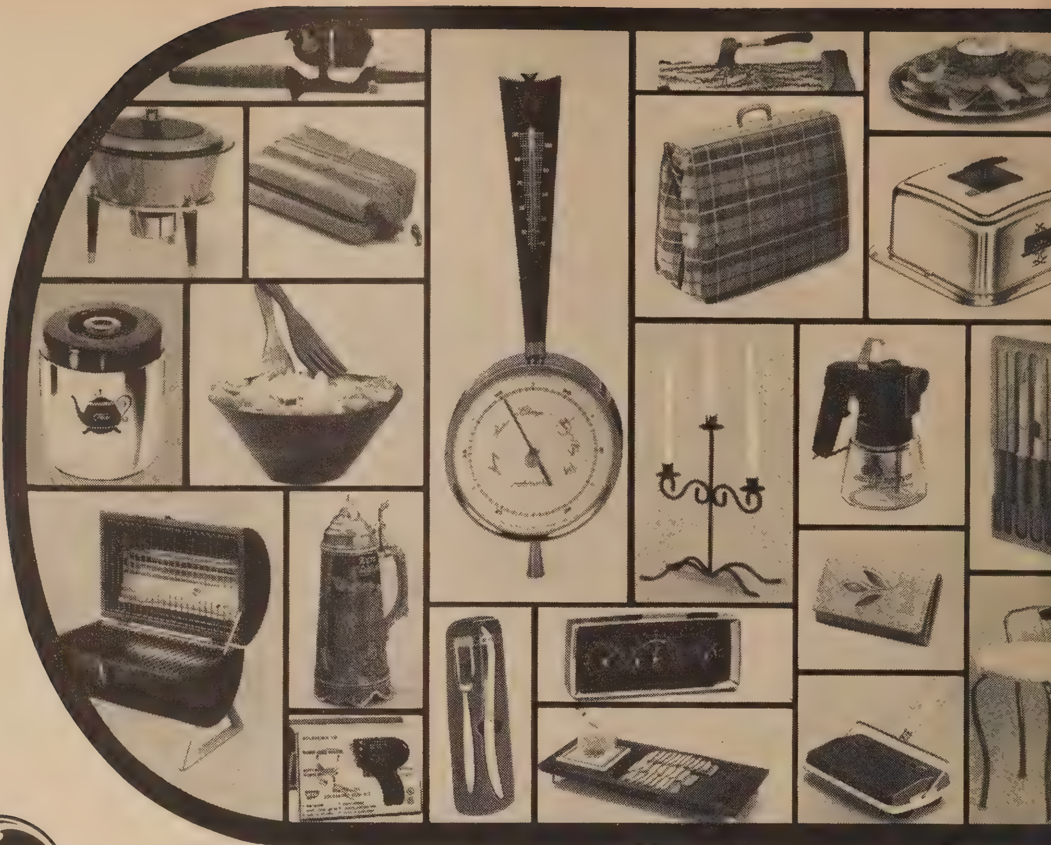
When frequency dividers get out of step, it *is* extremely easy to tell which one is not dividing. An experienced man can tell just by fingering the keyboard.

As far as the audio generator and frequency meter are concerned, I feel that it would be a white elephant for any organ service man! Organs have dozens of audio generators in them, so you can get any frequency from the organ itself. And if you can't precision-tune the organ with the frequency meter, the meter is useless. Normal hearing can detect an error of .01% in the pitch of a note in the tempered scale.

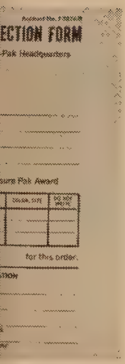
Normally the organ owner does *not* have a service manual for his instrument. Many organ manufacturers void their warranty if he requests one.

Labor charges should not be kept high. Nation-wide, the average yearly cost of maintaining a home organ is $15–20. This includes parts *and* labor. In traveling through the 50 states, I find that the better the organ man, the less he charges. [Interesting!—*Editor*]

At present, the electronic organ has penetrated only 3% of the population. Therefore, the need for organ men is *(Continued on page 18)*



pleasure pak


ECTION FORM

(Continued from page 14)

very small. The prospective organ service man should consider this very carefully. Organs are expensive to purchase but economical to maintain.

The books Mr. Kirk lists are fine.

Fort Wayne, Ind. R. C. BROUNSTEIN

Old Gernsback Magazine Available

Dear Editor:

Do you know of anyone who might be interested in acquiring a bound volume of the *Electrical Experimenter*, Vol. 2, May 1914 through May 1915? The copies are in very good condition. The whole volume was treated very well.

I would appreciate an offer.

RONALD VOIGT
4535 Cleveland
St. Louis 10, Mo.

Compliments, Mr. Powell; Some Symbological Notes

Dear Editor:

The pair of articles written by Mr. P. R. Powell of GM's Delco Div. ("Servicing 1963 Delco AM–FM Auto Radios," September–October 1963) deserves commendation. He has a fine style of writing and an economy of diction that is just right. He writes very convincingly, indicating an excellent acquaintance with his subject.

I hope some day you will write something about the transistor symbol fracas. The Swedish symbology appealed to me the one time I saw it in print. And I hope you always plan a wiring diagram so the base of the transistor is pointing left, the collector to the upper right, and the emitter at the bottom. I (and I'll bet there are lots of others, too) hate to have to stand on my head, so to speak, to study the symbols when they are drawn in a turned-around position. Electron tube symbols were seldom, if ever, in other than their normal tube-manual position.

Ann Arbor, Mich. LEWIS C. ERNST

[We do try always to arrange a schematic in the most logical way, but occasionally we have to sacrifice esthetic and intellectual perfection to the mundane demands of space and layout. And, of course, there are times when it is logical to run a transistor (or tube) symbol in other than the "tube-manual" position: for instance, in a push-pull or grounded-base (grounded grid) amplifier.—*Editor*]

Notes on "Hexnash"

Dear Editor:

A 5-ma meter, more readily available on the surplus market than the 1-ma meter shown in the Hexnash game (December 1963, page 82), can be used in the game if the resistors are changed to 300 ohms and the rheostat to 400 ohms.

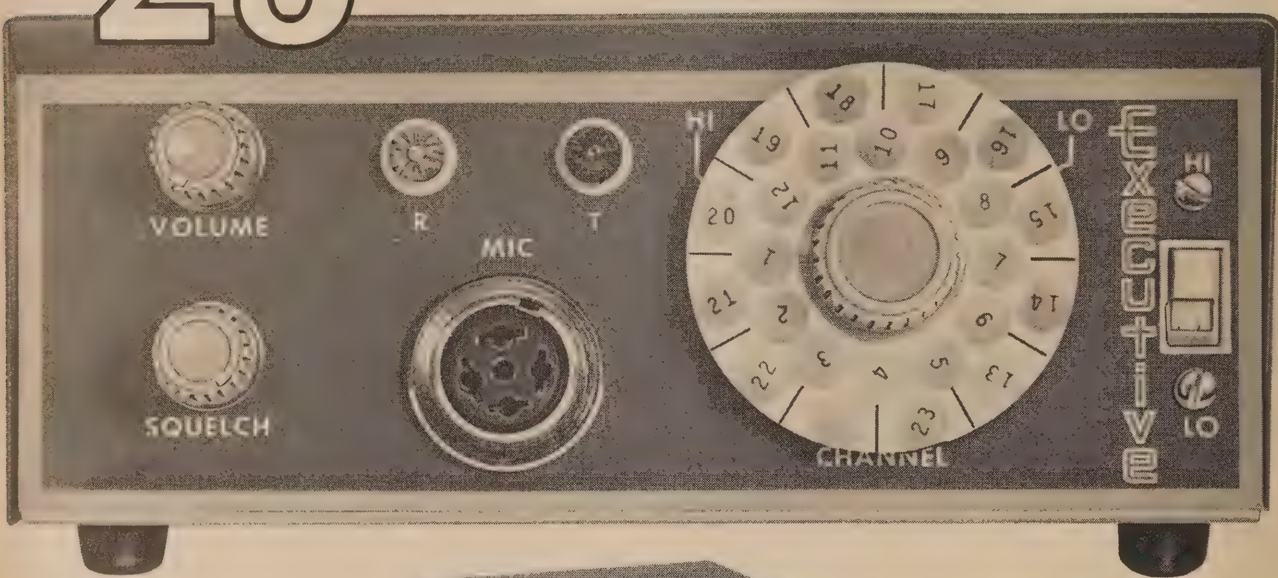
I found new surplus dp3t wafer switches at Fox-Wood Supply, 954 No. High St., Columbus, Ohio—13 pieces for $2, postpaid.

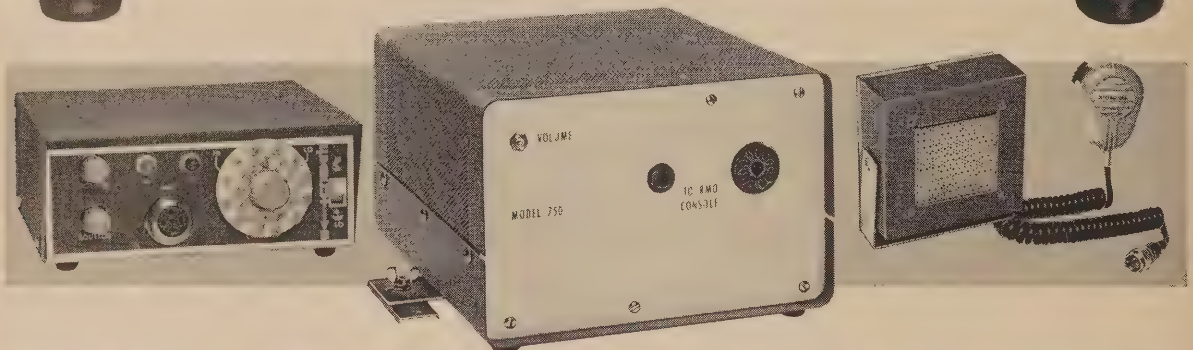
This game isn't as simple as it looks!

ROBERT F. WALLACE, PhD
Electrical Mechanics Institute
Columbus, Ohio

END

23 CRYSTAL CONTROLLED CHANNELS





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NEEDED: A NATIONAL FACTS CENTER

... Billions of Haphazard Facts Will Soon Drown Us ...

In our December 1959 issue, we wrote:

> An important government official, commenting on the chaos of electronic research, recently rebuked American research scientists for failing to make use of available Russian data. This occurred in early October, 1959, during the Chicago meeting of the National Electronics Conference, and was described in a news report:
>
> "John C. Green, director, Office of Technical Services, Department of Commerce, said his office began translating Soviet scientific reports more than a year ago and, because of the impact of Russia's sputniks, had expected these translations to total 25% to 50% of its sales of science papers. Actually, he said, they amounted to only \$50,000 out of the total of \$500,000, or 10%.
>
> "Mr. Green offered several reasons – researchers don't want new sources of information because they are already floundering in reports; some still discount the worth of Russian data, and others simply don't know the Russian translations are available.
>
> "What scientific research needs," Mr. Green declared, "is a new professional—'an information scientist'—to peruse the mountain of information and dispense relevant data to working researchers."
>
> "Floundering in reports" is stating the condition far too mildly—"drowning in reports" would, in our opinion, be more to the point.
>
> How could it be otherwise in an industry that mushrooms at such a fantastic rate of growth that it doubles its new inventions and devices every few years? What will the electronics field be in 10 years, 25 years, 50 years hence?
>
> Today we have millions of electronic facts available to our researchers. Soon there will be billions of facts—what then?
>
> Several times in recent years, research teams have developed 'new' devices, only to find that identical ones had been in use elsewhere for a different purpose. They had been fully described in technical papers, too.

Since 1959, an urgent situation has become well nigh desperate.

Useless, uncoordinated research and effort badly dog *every* industry today. Duplication in all endeavors is universal. Inventions or ideas are duplicated and "re-invented" periodically in countries all over the globe.

The amount of effort and money that goes into these foolish duplications is not only wasted but a constant source of embarrassment to their authors.

- Thus a technical description of radar was originally publicized with text and picture in the December 1911 issue of *Modern Electronics*. But the idea lay dormant for *24 years*. Then, with great fanfare, it was "re-invented" in 1935 by various persons.
- Early in 1964, the War Department made public its hitherto highly classified "television bomb" under its code name of "Walleye." This nonnuclear bomb, with a television camera in its nose, guides a bombardier to his distant target and is then exploded from its carrier plane, even in an overcast. It was fully described and illustrated 13 years ago by the writer in the January 1951 issue of Radio-Electronics.

Every inventor and thousands of technicians are only too familiar with these duplications and constant re-inventions all over the world. Not only are huge sums and fortunes expended endlessly on these useless redundancies, but every corporation, every large business is plagued with lawsuits from the original inventors and patentees.

One would think that patent offices the world over would know every patentable idea in every classification. Nothing could be further from the truth. Hundreds of thousands of patents are not worth the paper they are printed on—the same ideas were printed and explained in countless books, magazines and in the press years and decades before the patents were issued. Why?

- *There are only so many patent examiners and they cannot see everything, in dozens of different languages.* Hence, worthless patents are issued in every nation that has a patent office. Such patents then must be contested in court *after* they have been granted.

For this reason, the French—probably the first to do so—grant their patents *"Sans garantie du Gouvernement"* (without any guarantee by the Government). They learned from sad experience that a patent, in the majority of cases, was also an invitation to a patent suit.

The U.S. Patent Office is now hopelessly behind in its work. It takes an average of 3 to 4 years to obtain a patent. At the beginning of 1964 nearly 250,000 U.S. patent applications were pending! Experts tell us that we have far too few patent examiners, of whom most are grossly underpaid, despite the arduous, intricate work they have to perform.

It is also a sad state of affairs that, when finally a patent has been issued, the art has often long surpassed the patent—it has become antique and often useless, unless it has fundamentally new features. And such patents are rare.

How long is this unnecessary chaos going to go on, particularly in the United States, which has probably far more technical ideas, patents, processes and inventions than many other countries combined?

Patent processing techniques must be revamped before we bog down in such an avalanche of facts that it will take us decades to extricate ourselves. We repeat here what we have suggested several times in the past:

- *A National Facts Center* must be built and operated by the Federal Government. Only the Government is big enough to build and run such a center. *It would be far larger than even the Pentagon.* Nor would the information which it supplied be free—not any more free than present Patent Office services. Whatever information was demanded by any industry or individual would cost a scheduled statutory fee.
- The center would be equipped with possibly the largest array of electronic computers in existence. Every important scientific, electronic and industrial fact would be coded and carded, as well as cross-indexed in various categories. All these billions of facts would be fed to the computers in such a manner that, upon inquiry, the proper information could be given, often within seconds.

These facts and information would not come solely from American sources. That would defeat the whole purpose. Facts would be culled from every country of the world—only in this manner could the center be all-comprehensive.

The Facts Center would have to be closely allied with the Patent Office—each would be dependent upon the other.

In this manner industry, researchers, inventors and others would not have to waste their time any longer in useless research—the *key* to their problem would be forthcoming within minutes from the Facts Center. To be sure, the key itself would solve no problems—it would state, however, *where* your vital information could be found. It would be an immense shortcut for all research. *—H.G.*

A Lab-Quality Audio Generator

By JON IDESTAM-ALMQUIST

You'll be proud of this fine instrument

The completed instrument.

Sinusvagsgenerator = sine-wave generator
Dämpning i dB = attenuation ('damping in dB')
Yttre = outer (that is, external)
Hz = cycles (per second) — abbreviation for Hertz"

This article is for those who need an audio generator a little better than available kits, yet who can't afford the standard laboratory types. The generator described covers 1 cycle to 100 kc, with less than .03% harmonic distortion between 20 and 20,000 cycles.

The complete instrument is actually three independent parts: the generator circuit itself (Fig. 1), the frequency-determining network (Fig. 2) and the output attenuator (Fig. 3). The bridged-T frequency network and the attenuator can be modified to suit your purposes, and the attenuator can be omitted entirely or constructed separately for use with other devices.

The unit shown in the photos was built in Sweden, but the parts are standard and American equivalents can be used.

The oscillator circuit is about the simplest that produces stable, low-distortion sine waves over a wide range. It is known widely as the Bureau of Standards circuit (Fig. 1). Several commercial audio generators use the circuit, notably the Heath AG-9 (now the IG-72), around which this instrument is patterned.

The oscillator tube is a recent high-transconductance frame-grid pentode, a 6EJ7/EF184. The cathode follower is the well known audio beam power tube, the 6BQ5/EL84. Output amplitude is stabilized by two small tungsten-filament lamps, which operate at low temperature and about 3 mw input. They do not glow in normal operation. [The author used two 7-watt 240-volt lamps. The nearest American equivalents are the 10-watt 240-volt 10S6, and the 3-watt, 120-volt 3S6.—*Editor*]

The circuit provides two sets of output terminals, one a medium-impedance high-voltage output, on which the load should be 10,000 ohms or higher. Its output voltage is controlled by R12. The second output is for lower voltages and is controlled by the 600-ohm attenuator shown in Fig. 3. For accurate attenuation this output must be loaded with 600 ohms, either by the working load or by the internal 600-ohm load. If the external load is of high impedance, switch in the internal 600-ohm resistor.

If the oscillator control (R6) is set for 1 volt rms output at the low-voltage terminals, with no attenuation (the most convenient for calculations), the voltage at the high-output terminals is about 11 volts rms.

The attenuator provides loss up to 83 db in steps of 1 db. A continuously variable vernier (R11) allows intermediate settings.

If lamps other than the ones specified are used, the resistance values in the oscillator control circuit (R6, R7, R8) may have to be changed slightly to get the output voltages mentioned.

The bridged-T network

This generator follows the Heath unit in using switched fixed-frequency networks to provide accurate, easily resettable frequencies. It saves much time in making frequency runs and permits returning to a frequency exactly rather than approximating it on a continuously variable dial. To provide enough frequencies to make the generator useful, and yet to avoid having to use hundreds

Parts list for Fig. 1 (main circuit)

C1—50-50 µf, 450 volts, electrolytic
C2—32 µf (or 40 µf), 350 volts, electrolytic
C3, C4—200 µf, 250 volts, electrolytic
CH—filter choke, 22 h, 60 ma, 500 ohms (UTC S-27 is closest American equivalent)
F—fuse, 0.5 amp
J1, J2, J3, J4—5-way binding posts
R1—20,000 ohms, 1 watt
R2—100,000 ohms, 2 watts
R3—470,000 ohms*
R4—120,000 ohms*
R5—1,000 ohms*
R6—pot, 5,000 ohms, linear
R7—1,200 ohms*
R8—1,000 ohms*
R9—2,700 ohms, 25 watts
R10—2,000 ohms
R11—pot, 500 ohms, linear, wirewound
R12—pot, 3,000 ohms, linear, wirewound
R13—750 ohms
*Should be 1% deposited carbon type
T—power trans, 700 vct, 65 ma; 6.3 v, 1.5 a; 6.3 v, 0.3 a (Stancor PC-8408 or PC-8409 are closest American equivalents. Since they have only one 6.3-v heater winding, parallel all 3 heaters and omit ground to V2 heater. Connect to R1–R2 junction.)
V1—6V4/EZ80
V2—6EJ7/EF184
V3—6BQ5/EL84
10-watt, 240-v lamps (2)—G-E 10S6 or equivalent, or 3-watt, 120-v lamps (2)—G-E 3S6 or equivalent (see text)
Dpst on–off switch (toggle or rotary)
Sockets, chassis, cabinet, miscellaneous hardware

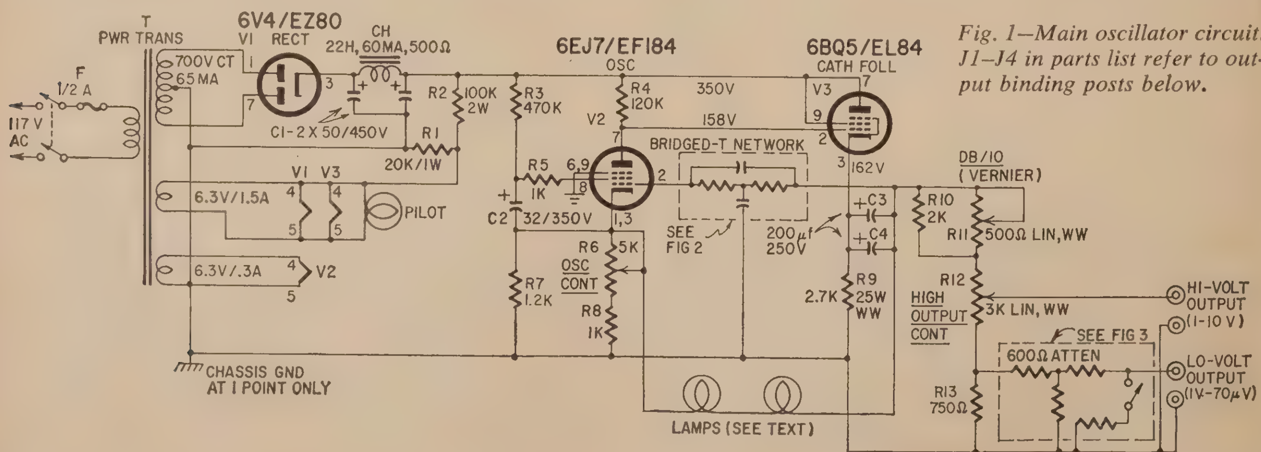


Fig. 1—Main oscillator circuit. J1–J4 in parts list refer to output binding posts below.

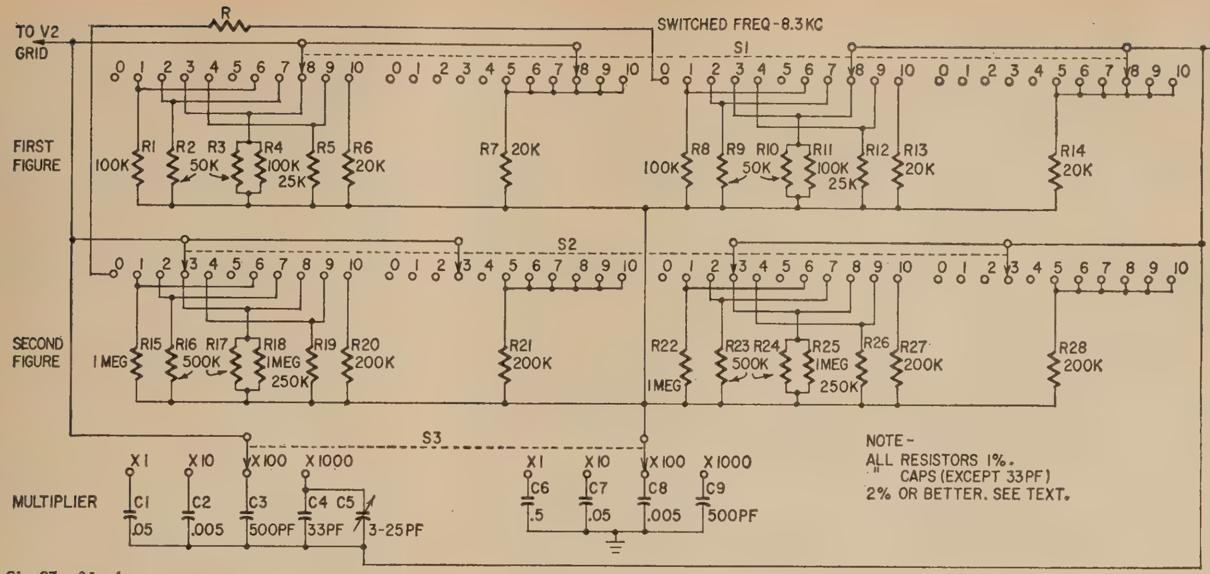


Fig. 2—Switched frequency-selective T-network the author used. Simpler, or variable, arrangements are also practical.

C1, C7—.05 μf
C2, C8—.005 μf
C3, C9—500 pf
C4—33 pf
C5—3–25 pf, mica or ceramic trimmer
C6—0.5 μf
All capacitors metallized paper, 200 volts, 1% tolerance (or selected with capacitance bridge)
R—100,000 ohms (see text)
R1, R4, R8, R11—100,000 ohms
R2, R3, R9, R10—50,000 ohms
R5, R12—25,000 ohms
R6, R7, R13, R14—20,000 ohms
R15, R18, R22, R25—1 megohm
R16, R17, R23, R24—500,000 ohms
R19, R26—250,000 ohms
R20, R21, R27, R28—200,000 ohms
All resistors ½-watt, 1% deposited carbon
S1, S2—rotary switches, 4 poles, 11 positions (Mallory 1241L or equivalent)
S3—rotary switch, 2 poles, 4 positions (Mallory 1215L or equivalent)

of separate networks, the switching scheme of Fig. 2 was used.

Two 4-gang 11-position switches set the first two significant figures of the desired frequency, and a 2-gang 4-position switch determines the decimal multiplier. With the system of Fig. 2, you can pick from more than 400 frequencies in range of 1 cycle to 110 kc. The ranges and their "resolution" are: 1–110 cycles in 1-cycle steps; 10–1,100 cycles in 10-cycle steps; 100–11,000 cycles in 100-cycle, and 1–110 kc in 1-kc steps.

If that's too complicated for you, you might use a simpler switching arrangement giving fewer frequencies such as the one in RADIO-ELECTRONICS, June 1958 issue ("Spot-O-Matic," by I. Queen, page 96). It uses three toggle switches plus a 4-position rotary for the decimal multiplier.

The resistors should be 1% deposited-carbon precision types, checked and matched in pairs before being wired in. The odd resistor R serves as a grid leak at "zero frequency," when the 6EJ7 grid would otherwise be floating.

The capacitors should also be 1% tolerance types, but, because they're so expensive, it might be better to pick precise values from stock capacitors with the help of a bridge. Try to match the values shown in Fig. 2 as closely as possible. If you can do that, you'll be rewarded with a frequency accuracy of better than 1%, and an amplitude variation of less than 0.1 db from range to range among the three lower ranges.

The attenuator

It is made up of seven T-pads giving 1, 2, 4, 6, 10, 20 and 40 db attenuation. The pads are separately switched and can be used in combination. The total attenuation of any combination of pads is simply the sum in db of the individual attenuations. The total loss can be varied from zero to 83 db (1 volt down to 70 μv) in steps of 1 db. Standard 1% resistors are used for most of the pads, but paralleling two resistors is necessary in some cases for best accuracy. Some pads are a compromise between exact attenuation and exact 600-ohm impedance match, but the attenuations (singly and in combination) are within 1% of the nominal values.

If you have the patience, you can pick out even more precise values. Try the table on pages 98 and 99 of *Basic Audio Course* (Gernsback Library Book No. 66).

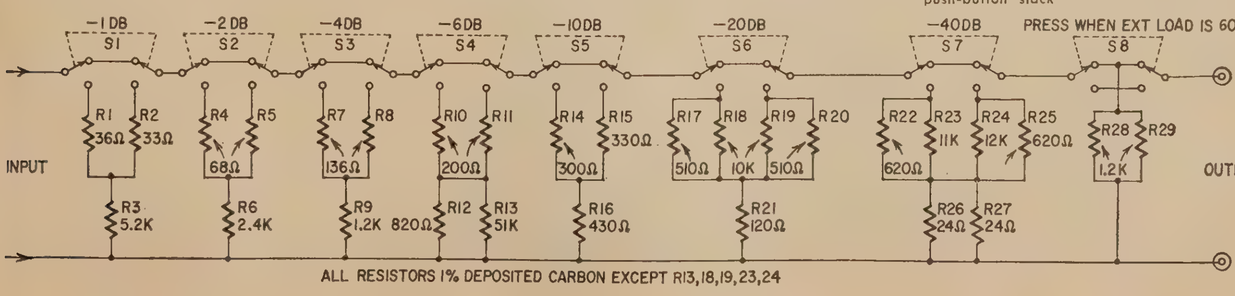
Test results

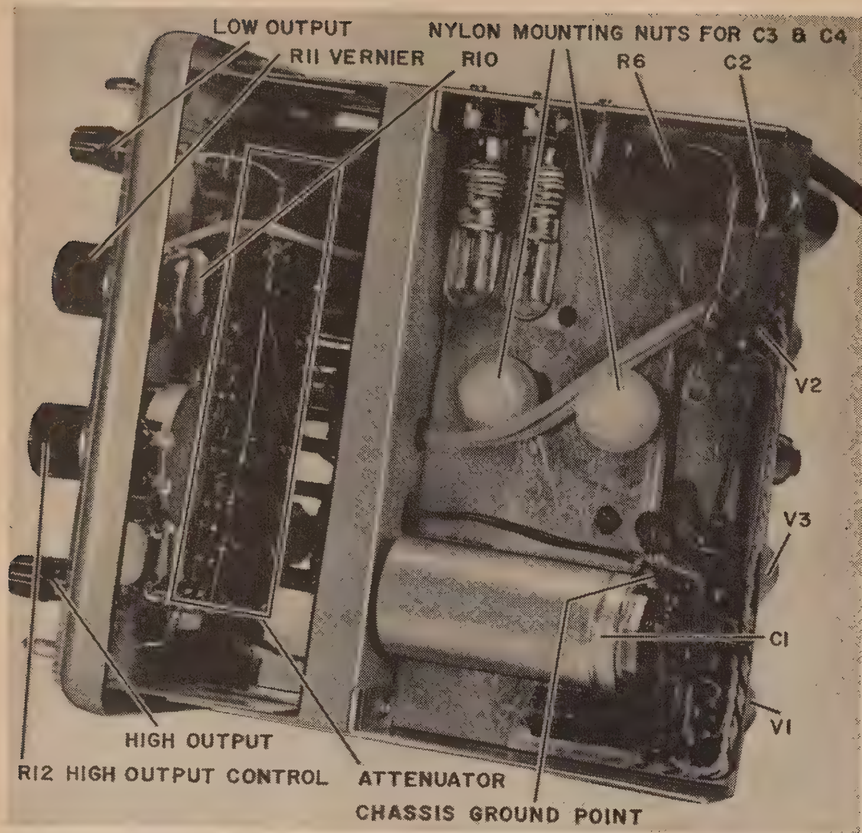
The completed audio generator was tested on a Hewlett-Packard 330B distortion analyzer and an H-P 524D digital counter.

Total harmonic distortion was so

R1—36 ohms
R2—33 ohms
R3—5,200 ohms
R4, R5—68 ohms
R6—2,400 ohms
R7, R8—136 ohms
R9, R28, R29—1,200 ohms
R10, R11—200 ohms
R12—820 ohms
R13—51,000 ohms*
R14—300 ohms
R15—330 ohms
R16—430 ohms
R17, R20—510 ohms
R18, R19,—10,000 ohms*
R21—120 ohms
R22, R25—620 ohms
R23—11,000 ohms*
R24—12,000 ohms*
R26, R27—24 ohms
*Can be 5% or 10% carbon composition types. All others should be 1% deposited carbon.
S1 through S8—dpdt toggle switches or 8-section dpdt push-button stack

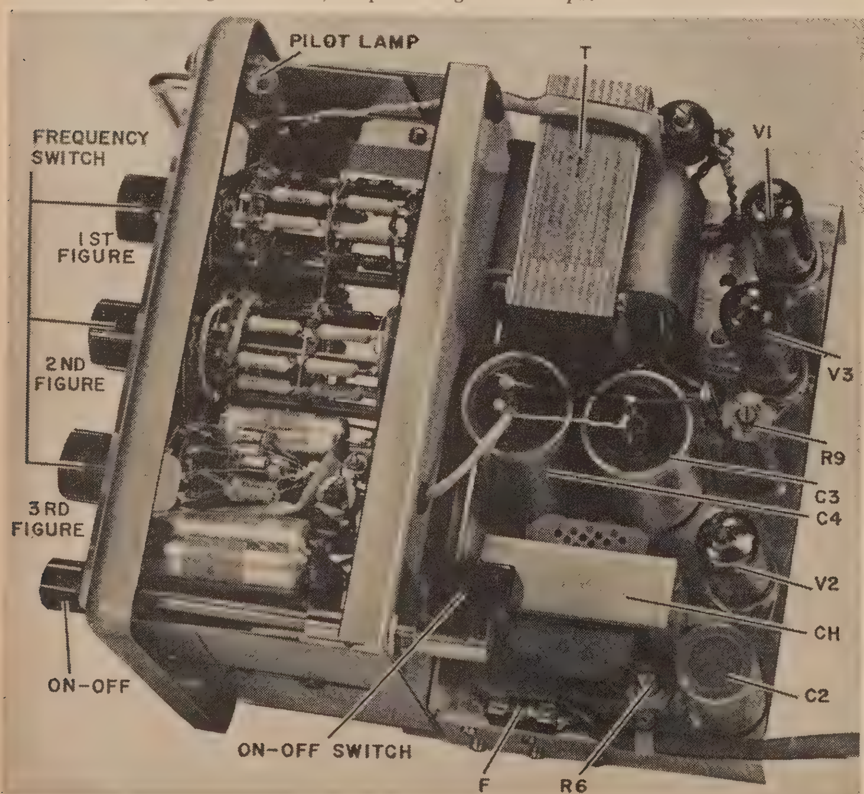
Fig. 3—Schematic of the 600-ohm precision attenuator. To give marked attenuation values, net must work into 600-ohm load, provided by R28 and R29 in parallel. If external load is already 600 ohms (as in some broadcast and professional work), R28 and R29 should be switched out with S8.

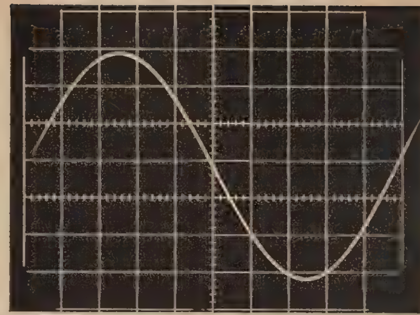




Top view (above). Chassis construction shows efforts made to shield frequency-selective and attenuation components from hum fields. Bridged-T is especially susceptible to hum at low-frequency settings (high resistances).

Bottom view (below). Ordinary American twist-tab can-mounting electrolytics are quite all right for C1–C4, but C2, C3, C4 must be mounted on fiber plates and grounded only via ground bus, to prevent ground loops.





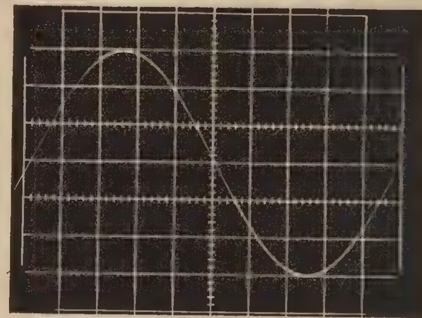


Fig. 4—These photos were made with a Polaroid camera and a Tektronix oscilloscope. The upper photo shows the generator's output wave form at 1 (one) cycle per second, and the lower one, at 100 kc.

low it could not be determined exactly. Within the limits of the analyzer (20 cycles to 20 kc), no figure greater than .03% showed up. A Heath HD-1 analyzer gave about .02% between the same frequency limits.

The two scope photographs in Fig. 4 were made at 1 cycle per second and at 100 kc. Frequency stability was better than 0.2% as the line voltage was varied +10%, —20%.

On the two lowest ranges (×1 and ×10), hardly any amplitude change was detectable on a wide-band audio voltmeter as the frequency was changed. At very low frequencies, the oscillator may take a few seconds to settle down and stabilize at a new frequency, but once it's there, the amplitude is constant and the same as at any other frequency in the range.

On the ×100 range, amplitude variations were noticeable, but never greater than 0.1 db. On the highest range, the variations were somewhat greater—about 1 db maximum.

These figures show that this is truly an instrument of laboratory quality, even though it is not expensive to build. I recommend it to all serious audio enthusiasts and technicians. END

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Bailey, "Low-Distortion Sine-Wave Generator," *Electronic Technology*, February 1960, page 64.

"Monitor", "For Golden Ears Only," RADIO-ELECTRONICS, May 1956, page 79.

Oliver, "The Effect of μ-Circuit Non-Linearity on the Amplitude Stability of RC Generators," *Hewlett-Packard Journal*, Vol. 11 No. 8–10, April–June 1960, page 1.

Queen, "Spot-O-Matic," RADIO-ELECTRONICS, June 1958, page 96.

ULTRA-SONICS STOPS BURGLARS!

By JOHN H. FASAL

The ultrasonic intruder alarm can detect anything that moves.

PROBABLY EVERYONE HAS NOTICED THE rising and falling pitch of a car horn as it approaches and passes at high speed (the Doppler effect). Why does it happen? While the blowing horn is approaching, each wave starts slightly nearer the listener than the preceding one. Thus the waves, traveling with constant velocity, need continuously less time to travel from transmitter to receiver and arrive there within decreasing time intervals. The result is the impression of an increasing sound frequency. The opposite happens if the blowing horn is moving away. Distances increase, travel time of the successive waves increases, and the result is the impression of falling pitch.

The Doppler effect is *still* apparent if the emitter and receiver are stationary, but a moving object between them reflects part of the emitted waves. The moving object behaves in this case like a moving transmitter.

The ultrasonic motion alarm, for which Patent No. 2,655,645 was granted to Mr. S. Bagno, is based on this principle. The patent, titled "Methods and Apparatus for Detecting Motion in a Confined Space," marked the beginning of a new era in the fight against crime. An ultrasonic alarm installation, combined with a foolproof annunciator and monitoring system, is a protective system not easily outwitted by criminals.

Ultrasonic motion detection

Fig. 1 is a diagram of the circuitry. The speaker radiates ultrasonic energy, generated by oscillator V4-b, into the room to be protected. If any part of the sound is reflected by a moving object, it reaches the pickup microphone at a slightly different frequency than the radiated ultrasound.

The received signal is amplified in the reflex amplifier (V2), passes through a high-pass filter, and is mixed in D1 with the reference signal—19.2 kc—direct from the oscillator. In the same stage, the beating (Doppler) signal is demodulated and fed through a low-pass filter back to the input of the tube. R11, connected into the low-frequency channel of the reflex amplifier, controls the strength of the low-frequency signal, which is further amplified, limited and

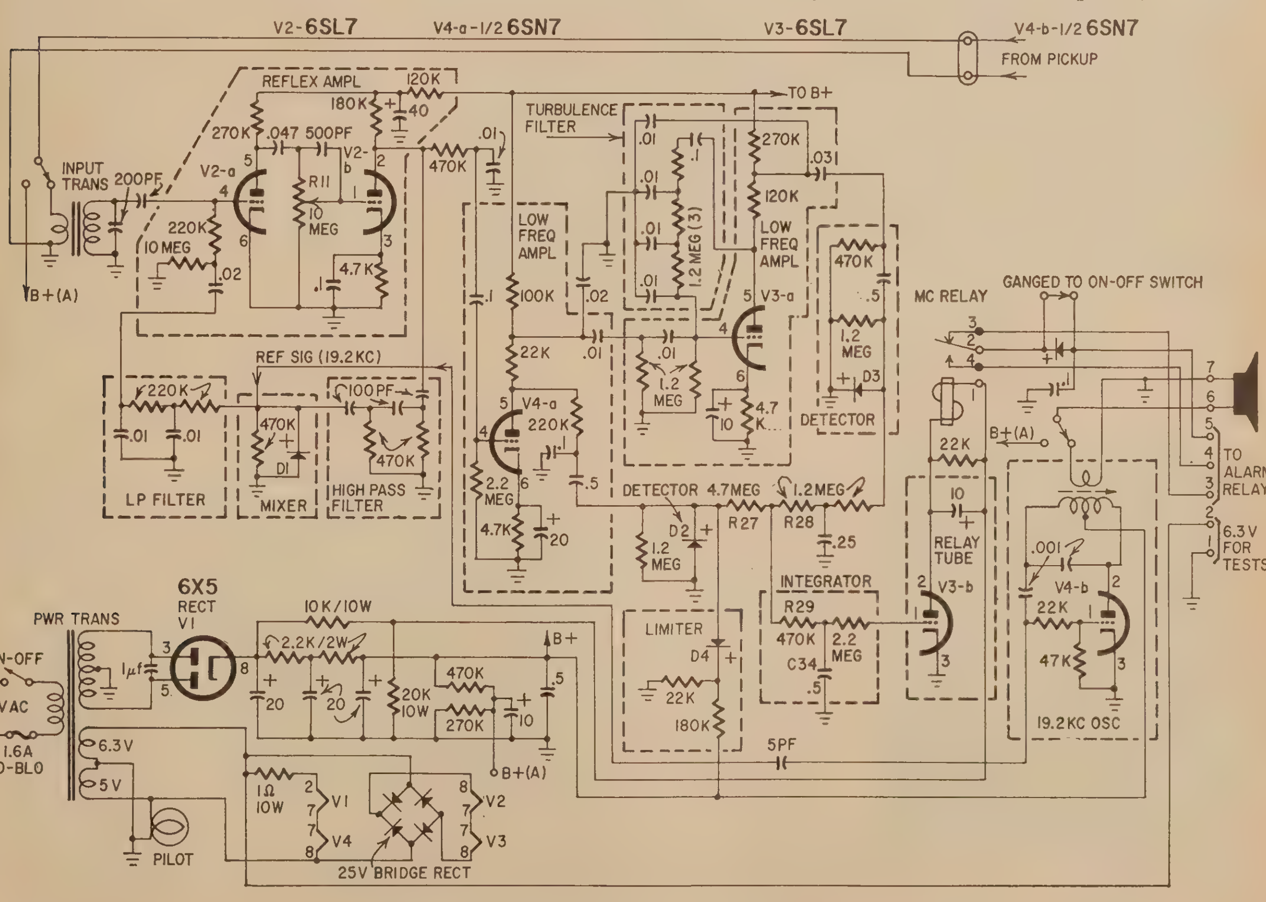
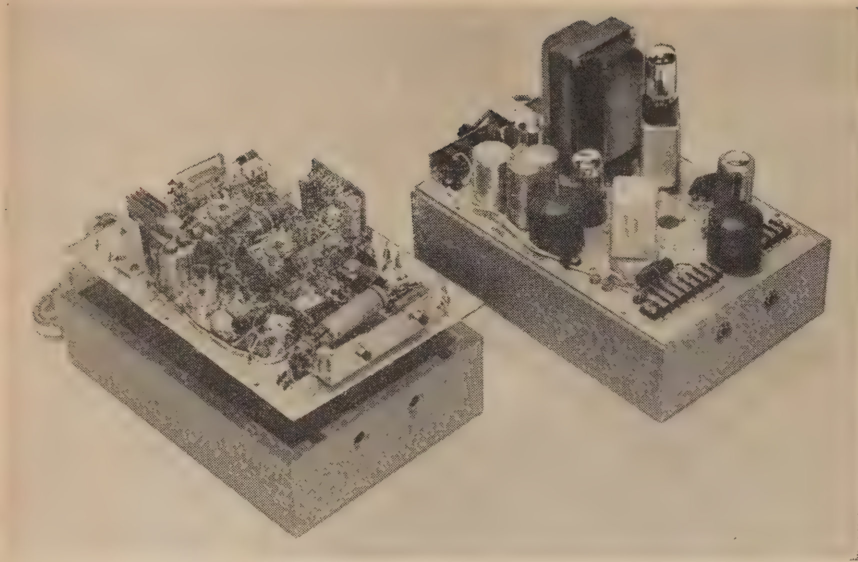
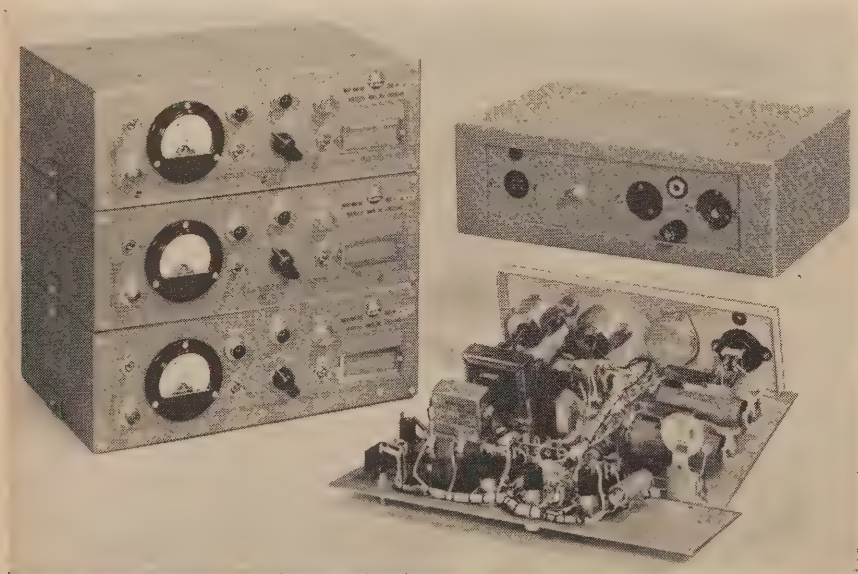


Fig. 1—Circuit of the ultrasonic motion alarm.



Master control unit, located in room to be protected.



View of the monitor unit. Units can be stacked to monitor several locations from one convenient point.

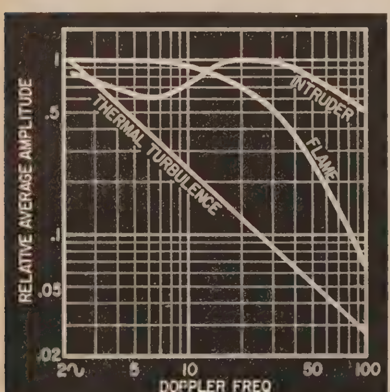


Fig. 2—Doppler signal spectrum for various disturbance sources.

converted to dc. The dc signal (integrated by R29 and C34, then fed to relay control tube V3-b) builds up after a few consecutive pulses to a level high enough to release the relay and trigger the alarm. This makes the circuit insensitive to random noise pulses.

The circuit is fail-safe; the relay is in the energized (armature pulled down) position in the non-alarm condition, and sounds the alarm in the open position. Therefore, if the relay circuit becomes inoperative for *any* reason, an alarm is sounded.

Why 19.2 kc?

Sound is reflected if it travels from a lower-density to a higher-density medium (or vice versa). The density of air is much lower than that of any solid, and therefore—provided a nonresonant condition exists—the reflection of sounds from a *solid* in *air* is practically 100%.

The ultrasound is thus confined to the protected room. There is no energy loss through the walls, and the system remains insensitive to motions outside them. This feature cannot be obtained by any other means.

It is, however, necessary that the frequency be high enough to prevent thinner parts of the boundary (such as doors or windows) from resonating and vibrating at the sound frequency. From this point of view, the frequency should be kept as high as possible. Unfortunately, the attenuation of a plane wave in air increases roughly with the square of the frequency. So we have to find a compromise between resonance loss and absorption loss. The best was found to lie between 19 and 20 kc.

System sensitivity

Just as in radio, sensitivity is limited by the signal-to-noise ratio. A unit with 1/10-watt output and using one speaker and one microphone can protect a room 100 x 100 x 20 feet against a moving object with a surface of .03 square foot, 100 feet away, under conditions of minimum noise and spurious turbulence.

There can be many turbulences other than those caused by intruders. Temperature change alters the velocity of the sound, and produces the Doppler effect. However, this change is normally too slow to trigger an alarm, though it does change sound absorption, which acts like a change in *sensitivity*. Turbulence produced by a fan, radiator or open flame is quite different from that produced by an intruder.

The relative amplitudes of the frequencies of the Doppler spectrum for different sources is given in Fig. 2. The Doppler effect produced by an intruder contains almost all frequencies between 2 and 60 cycles, with the peak between 30 and 40 and the low between 4 and 7 cycles. From 60 cycles on, the amplitudes of the Doppler signals decrease rapidly. A natural law determines the spectrum of turbulence: the amplitude is inversely proportional to the frequency so that it decreases in amplitude at higher frequencies.

A flame *generates* turbulence, while it also *reflects* sound like an intruder. As a result, its spectrum lies between that of an intruder and that of the turbulence. Flame does contain enough of the spectrum of an intruder to trigger an alarm.

By a clever idea which is the basis of the Bagno Patent No. 2,794,974, the effect of thermal turbulences is compensated by the turbulences themselves!

The very-low-frequency components that predominate in this kind of turbulence are used to produce a positive bias which counteracts the negative bias caused by the same turbulences at high frequencies. The negative bias produced by the Doppler signal of an intruder or of a flame remains unaffected. The positive bias, due to the very-low-frequency signal of the turbulence, has to be adjusted so that it compensates only for that part of the total negative bias which corresponds to the signal of the turbulence in its range. Fig. 3 shows how the compensation circuit works.

At the output of the second low-frequency amplifier (V4-a), the spectrum of Doppler frequencies is divided into very low and higher frequencies. Because of the polarities of diodes D2 and D3, the low frequency gives a positive dc output, and the higher frequency a negative one. The dc filters have a long time constant to get an average over a relatively long period of time.

Finally, the positive and negative output voltages are connected to a voltage divider (R27, R28) whose ratio is chosen to give proper compensation. The compensated dc signal (from the center of the tap of the divider) is integrated and fed to the relay control tube.

The transducers

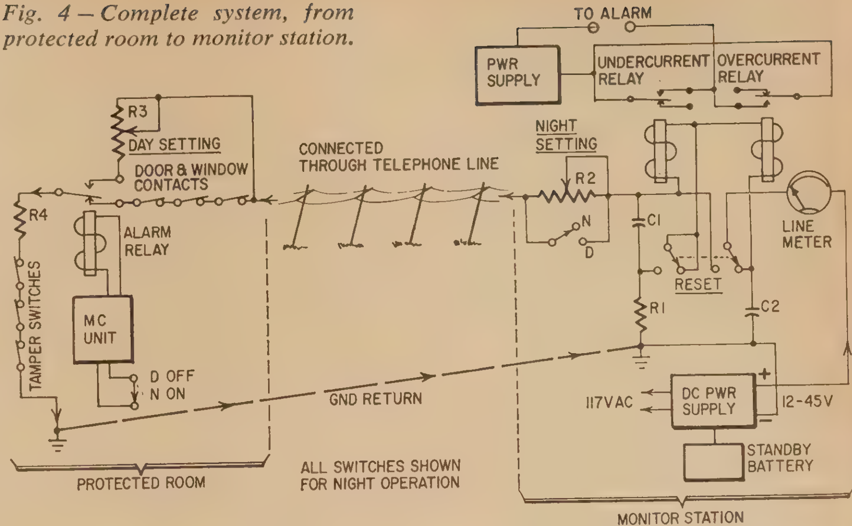
Both speakers and pickups are mechanically and electrically similar. Their operation is based on *magnetostriction*. When a rod of nickel (or other magnetic material) is premagnetized and put into an electromagnetic field, its length changes.

The transducers used for ultrasonic motion detection are certainly the simplest of their kind: a hard aluminum dome, resonating at approximately 19 kc, a pair of nickel rods 4½ inches long and 1/16 inch in diameter. Each rod is wound with approximately 1,000 turns of fine copper wire, and has a pair of mounting lugs that serve also as "matching transformers" between the electrical impedance of the rod and the mechanical impedance of the dome—that's all.

The electrical impedance of the magnetostriction transducers is very low. Long shielded cables can be used with no noticeable effect. The hemispherical shape of the dome gives a nondirectional characteristic, and a good mechanical impedance match, to the surrounding air.

The dome is suspended on three rubber-fitted screws and mounted in a flat pan which serves as a mounting post (see photo).

Fig. 4—Complete system, from protected room to monitor station.



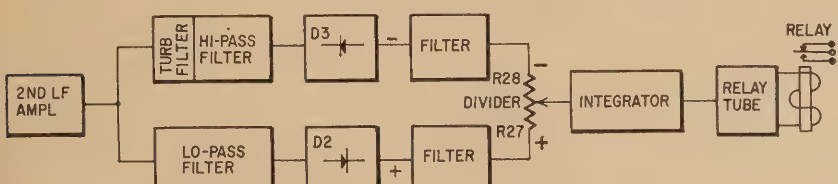
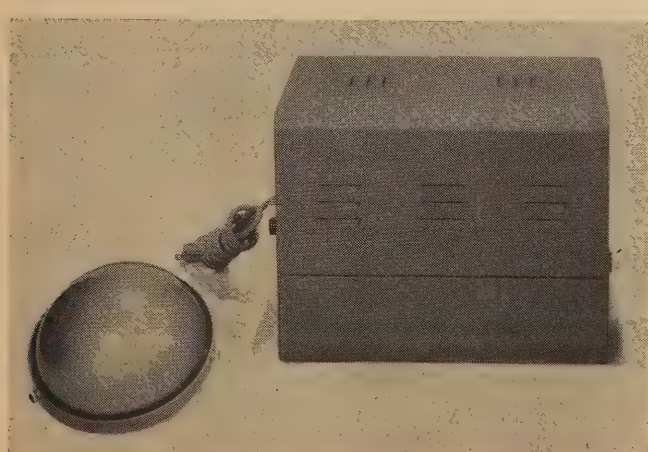


Fig. 3—Method of compensating for random thermal turbulence caused by radiators, cooling systems, etc. in the protected room. See Fig. 1 also.



Master control unit with its tamperproof cover, and pickup microphone. Speaker unit is identical to microphone.

Tamperproofing

An ultrasonic alarm system (or any other) can be fooled easily if there is no protection against tampering. This protection must cover not only the control unit, but all components, transducers, lines or switches that could be disabled to prepare for a later intrusion.

The basic protection is similar to that of a standard closed-circuit burglar-alarm system, with contacts that open if someone tries to gain access to a vital portion of the installation. These contacts are connected in series, and the alarm triggers when any pair is opened. Contacts are placed on the unit's boxes, transducer pans, and on windows and doors of the protected area.

A day-night switch is provided to turn off the intrusion section of the alarm during working hours, but the tamper-protection circuitry remains on continuously.

Further protection is given by undercurrent and overcurrent relays. The series of contacts, with the wires connecting them, have a certain characteristic resistance. Should someone try to short out part of this resistance as preparation for opening one of the contacts, he would trigger the overload relay. If he attempted to add series resistance to the line to substitute for the short, it would be very difficult to keep the line current absolutely constant, and either the under- or overcurrent relay would be bound to trip and trigger the alarm. Fig. 4 shows details of the complete system, including day-night switching and over- and undercurrent relays.

The security and reliability of the ultrasonic alarm system has, in fact, reached such a high degree that the old statement "crime does not pay" is certainly true in areas protected by one of these systems. END

COLUMN SPEAKERS SOLVE PA PROBLEMS

Pie-wedge radiation pattern gets sound where you want it, cuts echo and feedback troubles

By G. A. BRIGGS*

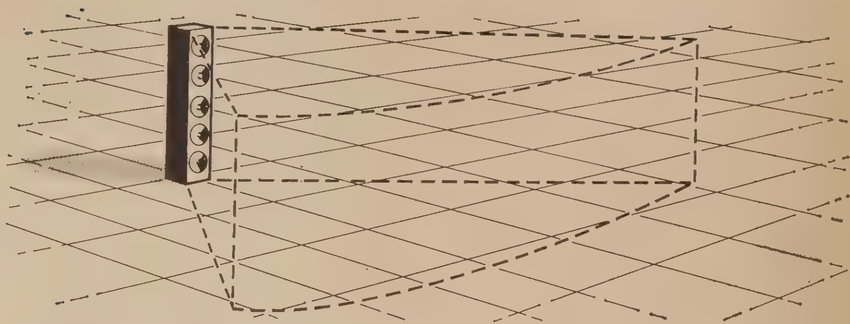


Fig. 2—Flat-beam pattern of columnar array is useful in many ways.

DURING SOME RECENT CORRESPONDENCE with the editor of RADIO-ELECTRONICS, the subject of column speakers cropped up and it suddenly struck me that we were not discussing the same thing. My idea of a column speaker was something like Fig. 1 in which an upward facing unit is mounted at the end of a circular or rectangular pipe or column, usually with a vent opening near the floor to help radiate low frequencies. This type of speaker has enjoyed a measure of popularity in the United Kingdom during the past 5 or 6 years.

But these columns have not caught on in America, where tall buildings in cities seem to be more popular than tall cabinets in living rooms. Incidentally, this type of speaker is not suitable for large rooms or halls because the vent opening is a long way from the speaker. This produces a rather ragged radiation pattern, not noticed in smaller rooms of average domestic size where wall reflections operate quickly.

We now come to column speakers similar to the one illustrated in the heading, on which the editor has invited me to comment. These are usually described in England as line source models, but will be referred to simply as column speakers during the remainder of my article. (When in Rome . . .) They certainly are suitable for use in large rooms, halls, railway stations etc. where clarity of speech is of prime importance.

Main characteristics

The main idea behind the column design is to project the sound forward in a flat, horizontal beam, roughly depicted in Fig. 2.

With five or more speaker units mounted in line, this type of directional control can be approached (but not fully achieved). The sound reflected from walls, floors and ceiling is reduced, and speech intelligibility is therefore increased in the audience area toward which the loudspeaker faces. In locations with a high reverberation time, the benefits are obvious, and Fig. 3 shows a school assembly hall with a couple of column speakers which give excellent results on speech and quite good reproduction of music but with restricted bass.

Early developments

During recent years, we have to admit that America has been ahead of Great Britain in several directions. You were 2 years before us in the introduction of microgroove records, and we are still playing around with the idea of starting a color TV service and multiplex stereo, now comparatively old hat with you.

But we can still claim to have invented the steam engine and, although column speakers have only been adopted in America during the past 2 or 3 years, they have been in fairly regular use here for more than 10, so we can at least

*Managing Director, Wharfedale Wireless Works Ltd., Idle, Bradford, England.

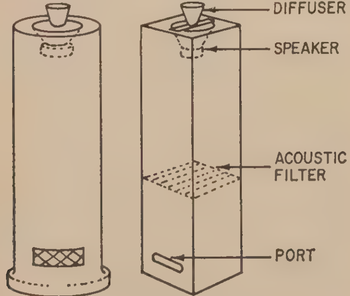


Fig. 1—This is not *the kind of column speaker we're talking about!*

Fig. 3—In this school auditorium, two column speakers hang at either side of stage.

Wireless World

Fig. 4—One of two 11-foot tall Pamphonic systems built in 1952 and used in the dome of St. Paul's Cathedral in London. There are eleven 10-inch and nine 3½-inch speakers, with crossover at 1,000 cycles. Frequency range is deliberately restricted to 250-4,000 cycles for best intelligibility.

claim to be ahead in the column! Fig. 4 is taken from an article by P. H. Parkin and P. H. Taylor which appeared in the February and March 1952 issues of *Wireless World* and shows one of a batch of eight column speakers then installed in St. Paul's Cathedral, where the reverberation time at 800 cycles is no less than 6 seconds with full congregation.

Three pairs of 6-foot columns were used in the nave of the cathedral, an interesting point being a time-delay system, arranged so that each pair of speakers operated at a time interval corresponding to the distance from the pulpit, plus a few milliseconds. In this way, all the sound appeared to be coming from the pulpit, due to the Haas effect (first sound to reach the ears). Echo effects were largely overcome.

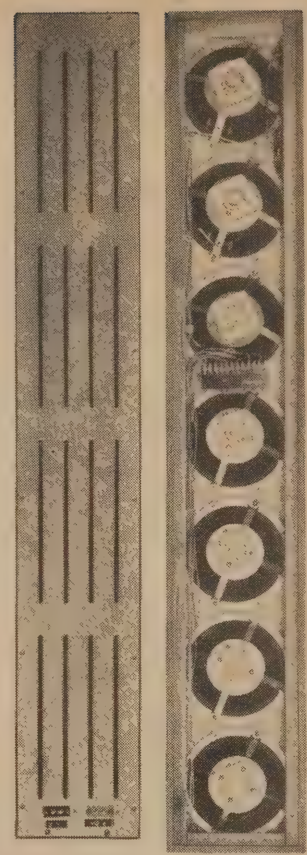
Design considerations

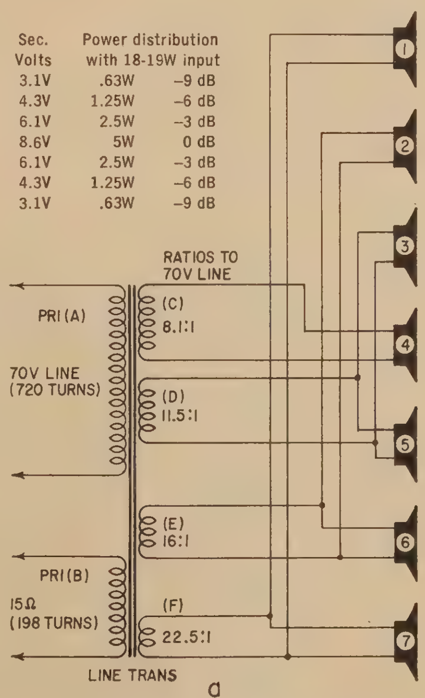
If all the units in a tall column loudspeaker are fed with equal power, the radiation pattern will contain large spurious side lobes. Cleaner results can be obtained if the power input to each unit is attenuated progressively as its distance from the center increases, although it is only logical not to attenuate too much. (If that is done, the end speakers become inaudible and it would be easier and cheaper to leave them out altogether.)

Another effect of severe attenuation is on power-handling capacity. If seven units, each rated to handle 5 watts without distortion, are assembled in one circuit, it would be reasonable to rate the total power-handling capacity at 35 watts. But if the units are attenuated in 3-db steps in pairs and we push in 35 watts, the center speaker would be overloaded by receiving 10 watts, compared with about 1½ watts to each of the end ones. It is therefore wise to halve the total power-handling figure when attenuation is used.

There are two obvious ways of arranging this attenuation. One is by fitting a specially wound transformer; the other by using constant-impedance volume controls. In Fig. 5 we show an exposed view of the Wharfedale LS/7 (with details of the universal transformer in Fig. 6). The slots in the back are covered with black cloth to form a sort of distributed port and reduce boxiness. The column is fitted with seven

Fig. 5—Wharfedale LS/7 (right) measures 60 x 9½ x 5½ inches, weighs 37 pounds.





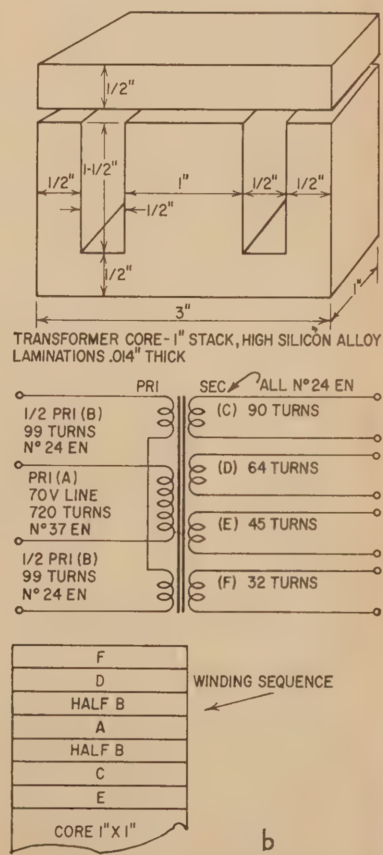


Fig. 6—In (a), hookup of seven speakers through special transformer that distributes power for optimum results. Drawing (b) shows construction details of transformer.

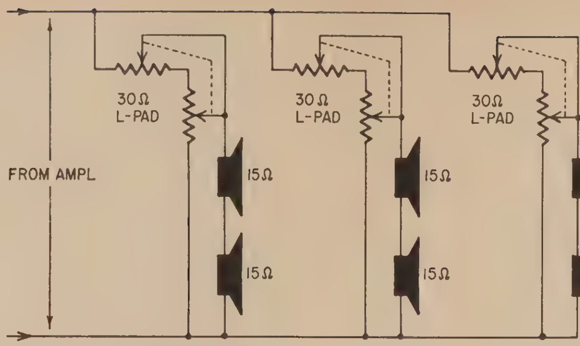


Fig. 7—Controlling pairs of speakers with L-pads. Total load impedance, with values shown, is around 10 ohms.

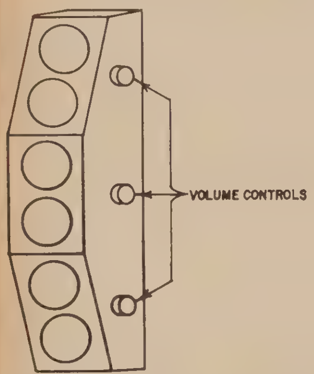


Fig. 8—"Beveled" front designed to reach listeners at different heights. Each section has its own volume control.

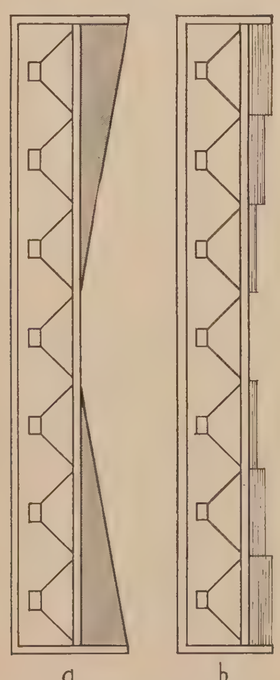


Fig. 9—Two approaches to tapering off high-frequency response of speakers away from center. In (a), pillows of glass fibre, cotton wool or bonded acetate fiber are built up in wedge shapes. In (b), blocks of polystyrene foam are placed in front of the speakers.

8-inch units and a tapped transformer to match 15 ohms input or a 70-volt line, and also to attenuate the input to the end units.

The winding details and dimensions of the transformer are given in Fig. 6-b. It will handle 20 watts rms without distortion or loss of bass. The primary windings are placed at the center of the coil to maintain reasonable coupling to the secondary windings for good high-frequency response.

A volume control is rather easier to arrange than the tapped transformer and also provides flexibility of control to suit conditions after installation. Fig. 7 gives a circuit for a six-speaker column, and Fig. 8 shows a design for extending the sound coverage vertically to reach people at different heights without the use of additional columns.

Mounted at a suitable height, such a configuration could cover a listening area to include box, orchestra and balcony seats.

Tone control

It is of course well known that loudspeakers become more directional as frequency rises and wavelength is reduced, so the radiation pattern is bound to vary somewhat with frequency even in a line source or column setup. Furthermore, the low-frequency output in columns is attenuated by the method of air loading, which suits speech better than music.

Some method of treble control may therefore be desirable. This can be done by connecting inductance in series with speaker units, say 4 mh to each end unit and 2 mh to the next couple.

Another plan is to apply acoustic treatment externally as shown in Fig. 9. This method is cheap and effective. with the additional advantage of being adjustable without opening up the enclosure. It was suggested in a paper by Klepper and Steele at the annual meeting of the Audio Engineering Society in 1962.

In Fig. 10 you see what happens at various frequencies when these materials are placed in front of a loudspeaker. (Glass fiber and cotton wool are similar to bonded acetate fiber in their effect.)

Using one of the waddings, it would be reasonable to start with a thickness of 4 inches at the ends, tapering to about 1 inch toward the center.

With polystyrene foam, density 1 lb/sq ft, the sound is much more attenuated, and a layer ⅞ inch thick over the end units, with say ⅝ inch and ⅜ inch in front of the next two, would be adequate.

The higher-density polystyrene should not be used unless you dislike the speaker *so* much that you wish to make it almost inaudible.

Due to the attenuation of output below 100 to 200 cycles, the column speaker is ideal for the reproduction of speech. Where music is of equal impor-

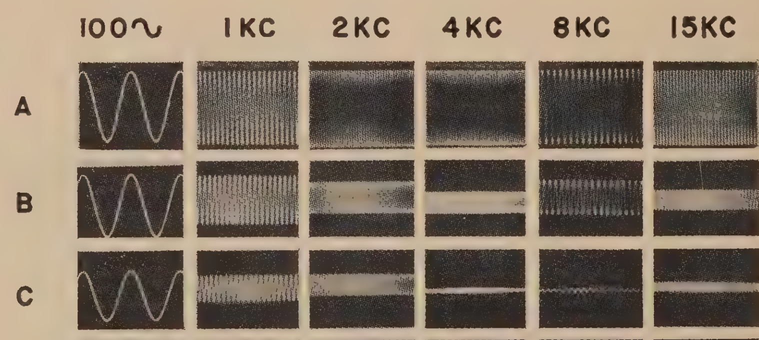


Fig. 10—Effects of high-frequency "muffling". Row A is the reference level for each of the six frequencies. In row B, polystyrene foam ⅞-inch thick, density 1 lb/sq ft was used. Row C was made with equally thick 2-lb/sq ft foam. Rows D and E were made, respectively, using 1-inch thick and 4-inch thick bonded acetate fiber.

tance, it is a good idea to combine a bass speaker with a column. A good choice might be the Wharfedale LS/6B, fitted with a 12-inch bass unit in a 2-cu ft reflex enclosure, and six 5-inch units in the column. The crossover is at 400 cycles, and separate volume controls for bass and treble enable fine adjustments to be made to suit the acoustics of the classroom or hall as well as to give any required balance on speech or music.

Home construction

We have given details of one or two specific models. A few general hints might be of use to the reader who wishes to assemble a column himself.

The basic idea is to make the column as narrow and shallow as possible, and assemble the units close together in the vertical direction to reduce spurious lobes of output to a minimum.

As the panel area is small, ½-inch plywood or chipboard is adequate and, if a slotted back is not used, the enclosure should be filled with glass fiber or similar absorbent material.

For reasonable results on speech *and* music, the minimum size would be four 8-inch units. These would require a column with outside dimensions about 36 inches high, 9½ inches wide and 5½ inches deep. The use of 10-inch units would give more bass for music but would probably require some low-frequency attenuation for maximum clarity on the spoken word.

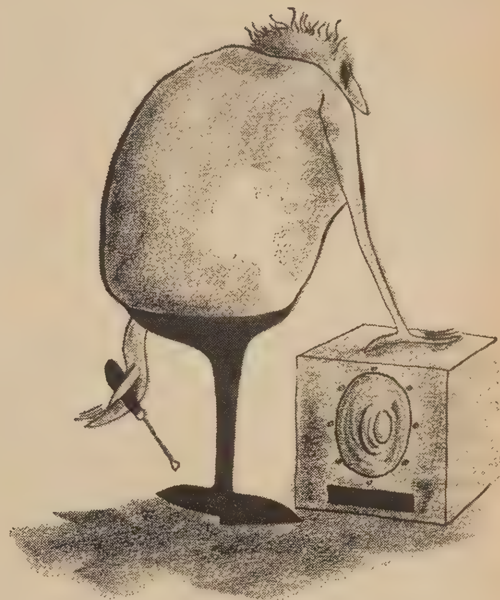
Where speech is the main consideration in locations of moderate size, half a dozen 5-inch units in a series-parallel circuit without end control could give excellent results at a moderate cost.

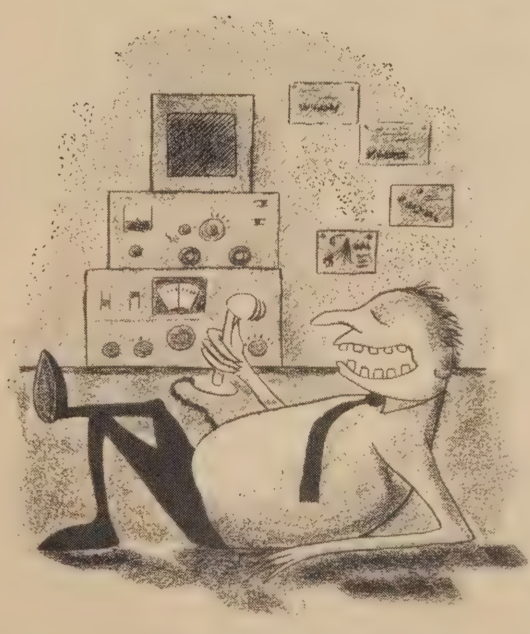
In conclusion, I should like to acknowledge the help of our technical manager, Mr. K. F. Russell, AMIEE, and his assistant, Mr. W. Jamieson, in the preparation of this article. END

ELECTRONICS PRIMER by SINCLAIR

1 Poor Hi-Fi Man

See the man.
He is a Hi-Fi nut.
He is installing a loudspeaker.
It is an expensive loudspeaker.
See the screwdriver slip.
The man is crying.



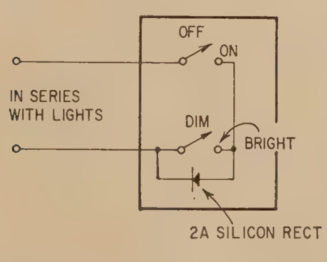


2 The Bad CB'er

See the CB'er.
He has a very high antenna.
He has modified his transmitter.
He calls: "CQ, CQ."
The CB'er talks all the time.
Soon he will be talking with the FCC.

Dim Those Lights!

A SOLID-STATE LIGHT DIMMER COSTS only about $3, so there is little you can save by making your own . . . but you'll



have the fun and pride of "do-it-yourself." A dimmer uses a silicon diode in series with an incandescent lamp to block alternate half-cycles of current. This drops the illumination to less than half. The diode polarity is unimportant.

The dimmer needs three positions: dim, bright and off, but a spst wall switch is not generally available at reasonable cost. I used a dual spst type which sells for 54¢. A dual-cutout plate to fit over it sells for 39¢. I bought a 2-amp 400-piv silicon diode for 30¢ (at Leeds Radio Co., New York City).

Connect as in the diagram. The upper switch is on or off. The lower one switches from bright to dim. I use this arrangement to control three 60-watt incandescent lamps.—*I. Queen*

INSTALLING & TROUBLE-SHOOTING UHF

Part I: Uhf tuners and converters have a lot in common: they aren't hard to fix **By HOMER L. DAVIDSON**

UHF IS COMING FAST. COMMUNITIES never before in reach of reliable TV are now seeing programs regularly, via local stations or through translators. Converters, also called tuners, now come in three kinds: built into the set, new; wired into an existing set, or connected externally as an accessory.

Most of these tuners are quite simple. A uhf tuner consists of tuned rf cavities, oscillator and mixer. The uhf tuners in TV receivers have a switch that mounts on the rear of the vhf tuner or inside the present tuner. It switches the signal from the antenna to either the uhf or vhf tuner and—in the uhf position—from the uhf tuner to the vhf tuner (which acts as an additional i.f. amplifier) or direct to the i.f. section of the TV receiver. Also, the B-plus is switched between uhf and vhf tuners. (This switch is part of the uhf tuner as purchased.)

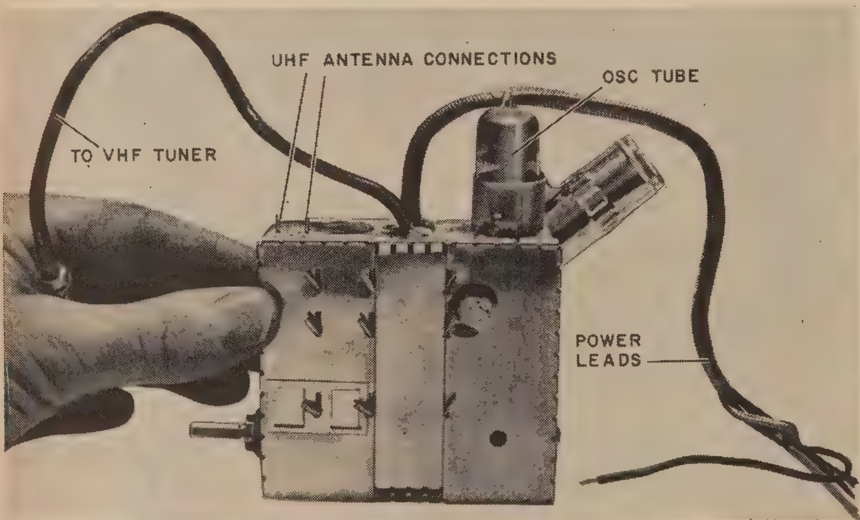


Fig. 1—A Sarkes Tarzian uhf tuner.

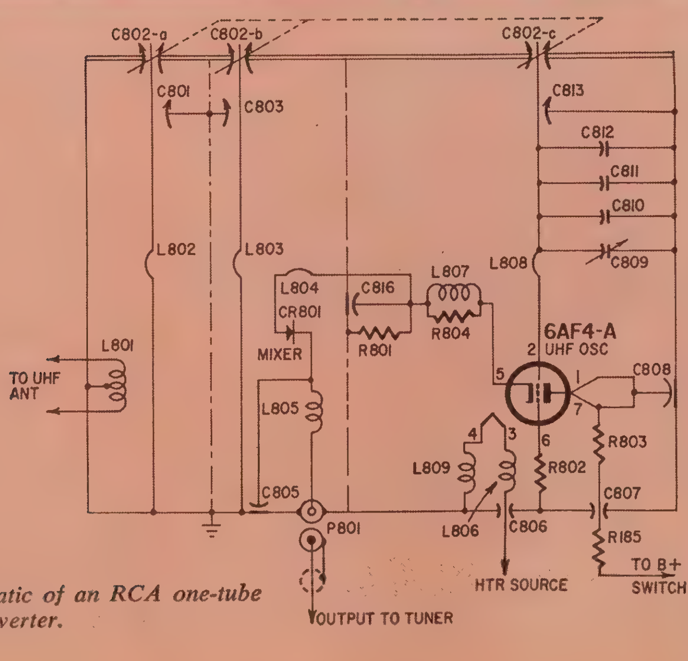


Fig. 2—Schematic of an RCA one-tube uhf-to-vhf converter.

Fig. 1 shows a typical uhf tuner, and Fig. 2 is the schematic of a very popular type. This tuner is used in many TV receivers today. The uhf oscillator tube is either a 6AF4 or 2AF4. The oscillator tube causes 90% of all uhf troubles. It will either burn out, short and become intermittent or, after a few minutes, quit oscillating. Some new tubes will not perform correctly on channel 70 and higher. The uhf channel is still snowy. Try new oscillator tubes until you are pleased with reception. Many times the customer will say, "Channel 21 will stay on for only a few minutes and go off." You can bet your bottom dollar it's the uhf oscillator tube.

When there is no signal at all, the trouble is easy to find. Replace the oscillator tube and crystal mixer, then take voltage readings.

A defective uhf crystal mixer, such as a 1N82A diode, will cause a snowy picture. We have had some that were open, but very few. If the oscillator tube has been replaced with a good one, try the crystal next. Figs. 3 and 4 show the location of the crystal mixer. It is soldered or clipped into the circuit. Try several crystals until the picture clears to normal.

Sometimes the crystal polarity is reversed and the picture is much better on the higher uhf channels. If the crystal solders into the mixer circuit, try several crystals and pick the best before soldering. Do likewise when the ends of the crystal are to be snipped off and placed into short cup sockets. Do not apply too much heat to the crystal when soldering. Use a pair of long-nose pliers to absorb some of the heat.

If the uhf signal is still snowy or there is no signal at all, take voltage readings on the uhf tuner. The B-plus voltages will read from 60 to 120. Measure the grid voltage at the pin with a vtvm; it should fall between 1.5 and 6 volts negative.

Suppose the oscillator tube and diode have been replaced and all voltages seem to check good, but channel 70 is still snowy. Tune in a station on a lower channel. If this signal is clear, the antenna must be good. Our trouble is still in the uhf tuner on the higher channels. Check the rf cavity section (Fig. 5) visually. If one of the rotor plates is touching a stator plate, we will get snow. (Signal strength is also a factor—one of the higher uhf channels may be a low-power translator station.)

Check the rf cavity for shorted plates in the antenna circuit. (You cannot use an ohmmeter here; the end of the inductance bar is grounded to the cavity case.) At the other end of this inductance the stator plates are welded on. Take a closer look and see if the plates are touching on channel 70. These plates are generally copper and very easily bent. Go to the second cavity and check those plates. You will generally find one set of plates not meshing properly.

How do these plates ever come together? The stator plates are fastened at the end of the inductance bar and after long use, the bars seem to twist. Also, the screw adjustment in the bearing ends loosen, causing the plates to touch. When a plate touches in the antenna section, there is hardly any picture at all on uhf. If a plate touches in the second cavity section, the picture is there but quite snowy. This, of course,. will depend on the signal strength of the TV station, and on high or low channel.

An intermittent or microphonic tuner is caused by a bad oscillator tube, loose or dirty contacts on the crystal mixer diode, bad tube-socket pins, or a bad soldered joint in the oscillator section. Move the oscillator tube around in the socket and see if the picture cuts out. Pull or pinch the tube pins together with a sharp pointed instrument. If there is a bad solder connection on the grid oscillator bar section, be careful when soldering. A bad soldered joint or too much solder will mess up the works. Clean all switching contacts in the vhf and uhf tuner with tuner lubricant. Also, check the rotor bearing and wiping blades for poor contact or grounding. Use a stiff brush to clean all dirt and dust from the tuned cavities. TO BE CONTINUED

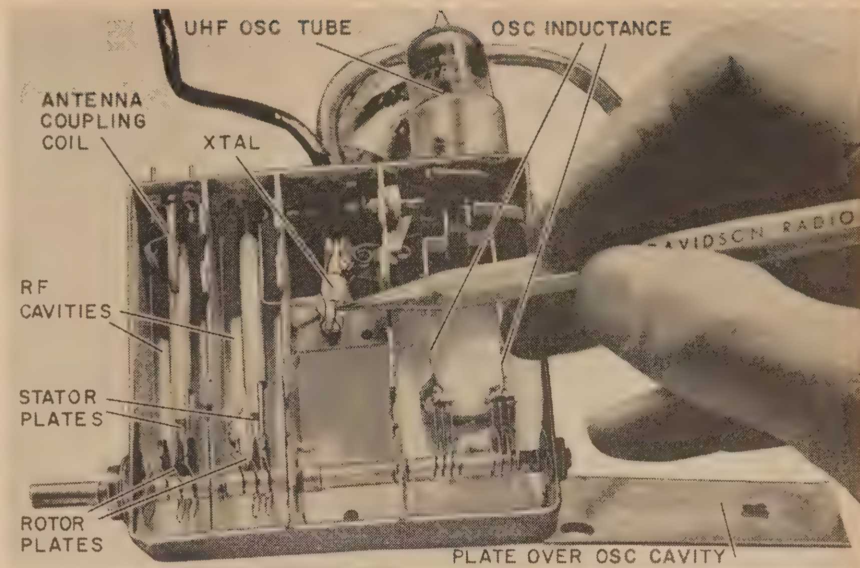


Fig. 3—In one-tube tuner, mixer crystal fits into tiny clips (pencil point).

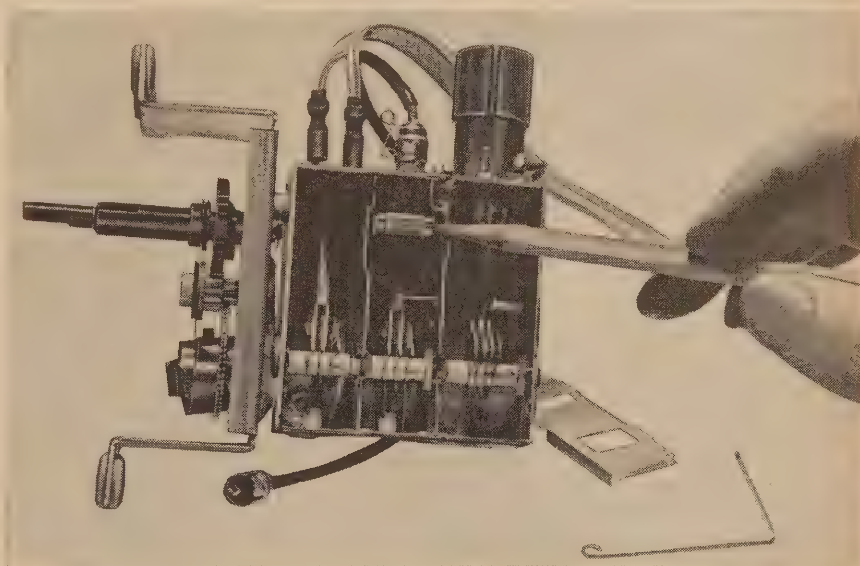


Fig. 4—Different crystal, same kind of mount.

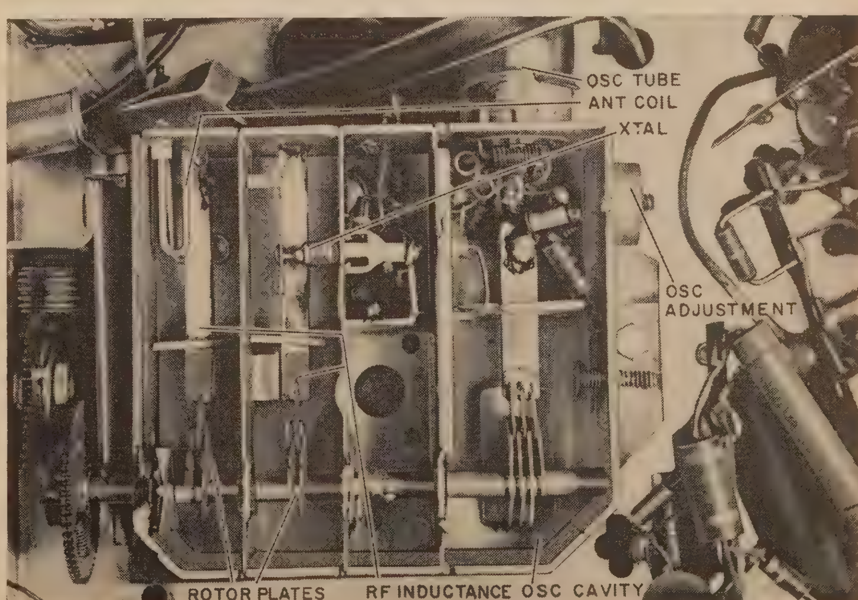


Fig. 5—Uhf requires new kinds of circuits. Here "cavities" are integral parts of tuned circuits. Note mixer crystal (soldered in, this time) between second and third compartments.

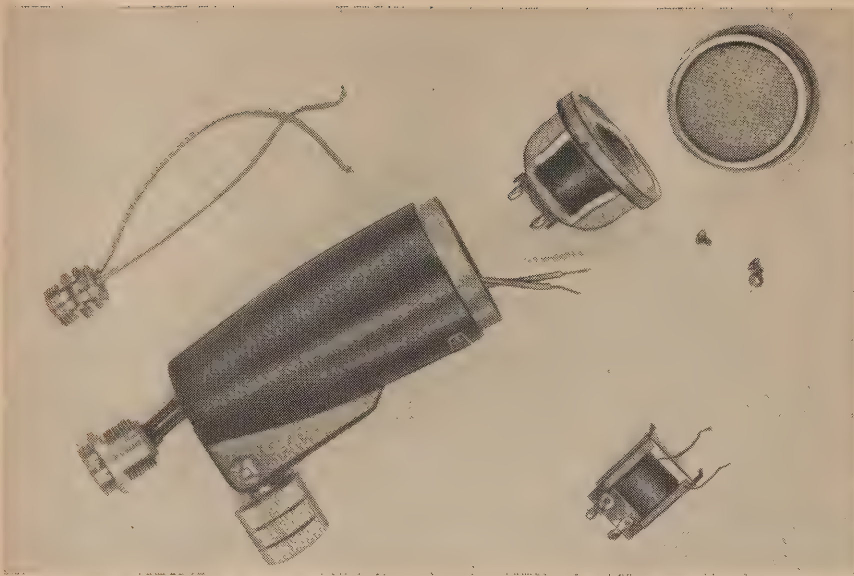


Fig. 1—Modification of an inexpensive dynamic mike. It comes apart easily. Transformer (lower right) was on back of dynamic element; it will now be reinstalled at remote point. Original miniature connector is replaced with Amphenol 80PC2F (shown wired in place). Larger hole must be drilled for it.

By ELMER C. CARLSON

UPGRADE your home recording setup

Don't be hobbled by 6-foot mike cords—make your line lo-Z and run it 100 feet if you like. And add a mixer

BROADCASTING AND RECORDING STUDIOS have one advantage that the average home recordist has to do without. They can use microphones regularly at locations that require 100 feet or more of wire to reach the control console.

An inexpensive compromise for home or PA work is to convert the high-impedance dynamic microphones listed in most catalogs. Some models cost less than $10. This won't solve all your problems, but at least you won't be hobbled by the mike cable.

The modification has little effect on the frequency response of the microphone. Pickup of music, using 150 feet of cable, revealed little loss of high frequencies when compared to the original microphone with its short cable.

These microphones have high-impedance output by virtue of a low-impedance microphone-to-50,000-ohm transformer mounted in the same case with the low-impedance microphone cartridge (Fig. 1). Without the transformer, the microphone is a low-impedance device.

The transformer may be removed and the microphone wired directly to a new two-wire cable connector.

[Better-grade dynamic microphones ($20 and up) come with dual impedance (150 ohms and high-Z) outputs. With 150 ohms output you can use any length of cable with no significant attenuation. At the recorder end of the cable install a shielded cable-type line-to-grid step-up transformer (cost: $10.50) to match the recorder input.—*Editor*]

For use over longer distances, use two-wire shielded cable even though one of the wires of the microphone circuit (Fig. 2) is connected to ground at the amplifier. This extra precaution insures hum-free pickup. The shield grounds the microphone case and any capacitive pickup on this outer conductor. The twisted pair inside the shield is, for all practical purposes, balanced. Its two wires are equally exposed to any other stray fields. Signal voltage and hum pickup by the twisted pair should nearly cancel.

At the amplifier end, it is now necessary to step up to a high impedance to match the amplifier input. For best results, use a transformer with a primary impedance equal to that of the microphone coil. What is the impedance of the coil? In all probability this is not marked and it will be very difficult to measure without special equipment. Why not use the transformer that came mounted in the microphone case?

Theory tells us that if a generator (in this case the microphone coil) is fed into a line (microphone cable) of the same characteristic impedance and loaded with this characteristic impedance (the microphone transformer), it will not discriminate against frequencies. The line can be infinitely long and will act as a pure resistance.

This is important where lines are many miles long—to the telephone companies, and to broadcast stations that use telephone lines to carry program material to a distant transmitter site.

For our purposes, 100 feet will usually be more than enough, and will have little effect on the frequency response. The ohmic resistance of 100 feet of even fairly heavy-gage mike cable may be a substantial fraction of the microphone voice-coil resistance—perhaps even equal to it. Thus there could be as much as a 6-db signal loss in the cable, which would make the system susceptible to hum pickup. This loss affects all frequencies by the same amount.

Mixers

Commercial installations have another advantage: facilities for more than one microphone, each with its own level control. These are called *mixers* be-

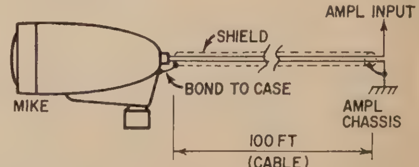


Fig. 2—Two-conductor line is vital for low noise pickup. Shield braid grounds mike case, putting induced hum voltage in series with case and amplifier ground, not in mike signal circuit.

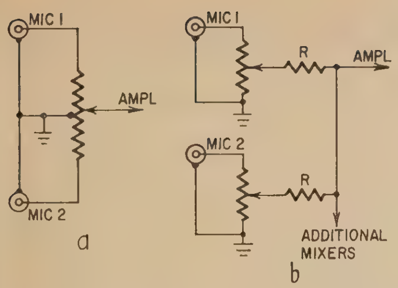


Fig. 3—(a) Fader uses center-tapped volume control of twice-normal resistance; only one input can be used at a time. In (b), popular passive mixer circuit is expandable, but 4 channels is usual maximum. Isolating resistors R should be same value as volume controls.

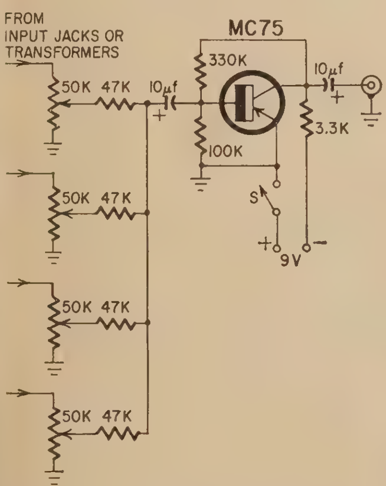


Fig. 4—Inexpensive accessory mixer is completely self-contained, with one transistor and 9-volt battery. Manufacturer claims 6 db gain (over insertion loss) and zero hum level.

cause they allow two signals to be mixed as they are controlled.

Most mixer circuits are fairly simple. The one shown in Fig. 3-b has one thing against it—*insertion loss*. We lose a little of the signal voltage because the control has been connected (inserted) into the circuit. This is not important in a commercial installation that uses an *active mixer*—a mixer that adds at least as much gain to the circuit as has been lost through the control insertion loss.

While the average home recorder has gain to spare with only one microphone, there often isn't enough to compensate for the losses in a *passive mixer*.

A simple and probably more satisfactory method than either passive mixing or modifying your recorder is to use a mixer–amplifier that has one transistor and a battery supply (Fig. 4) in a very simple circuit. It will compensate, usually, for the insertion losses without adding any hum.

Once the microphone transformers have been mounted in a suitable case to protect them from physical damage (it is possible to mount some miniature transformers right in the mixer–amplifier chassis box as in Fig. 5), it is time to test the system.

When all the microphone and cable connectors are in place, there should be little, if any, additional hum if the system is wired and operating properly.

A sizeable hum-level increase indicates a defective ground or transposed connections in one of the connectors or junction boxes.

It is simple to troubleshoot the cable and microphone circuits without test equipment. First disconnect each cable in turn from the mixer–amplifier. If it is possible to *monitor* the recorder with earphones or through the speaker while recording, you can save time—no rewinding or switching.

Should disconnecting the input cables make no change, disconnect the mixer–amplifier from the recorder. Any trouble from a defect in the mixer circuit is now removed and the recorder should operate normally.

Disconnecting each microphone, in turn (or turning down its mixer control), will usually indicate the defective channel. Try reversing the line-cord plug.

As a last-ditch hum-reducing effort, try grounding the recorder or mixer-amplifier. The wall receptable-plate mounting screw might help. A hot-water heating system pipe should work but a cold-water pipe is best for grounding.

In permanent installations, you may want to use concealed wiring with termination boxes (Fig. 6) and microphone connector plates. When hum persists, try grounding the boxes too.

Junction boxes will probably have to be custom-made for each installation. Basically, a junction box is a point where wires may be conveniently joined—where the lines enter and leave their concealed locations and change from one type of wire to another. While the wire used for the permanently installed portions of the system *must* be two-conductor shielded, covered cable, it does not have to be as flexible as that used for a frequently moved microphone. With a mike cable, flexibility is of the utmost importance. The more flexible the wire, the less likely to break.

Junction boxes are not necessary for temporary installations. The flexible cables plug directly into the rear of the mixer–amplifier. Microphone cables should be a good heavy-duty type—cut into 25- or 50-foot lengths with sturdy connectors that lock together and prevent accidental disconnection by people walking on them. END

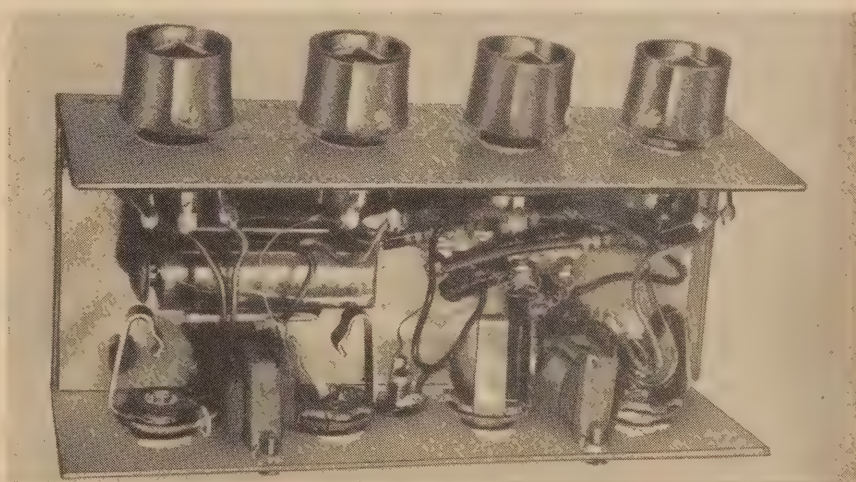
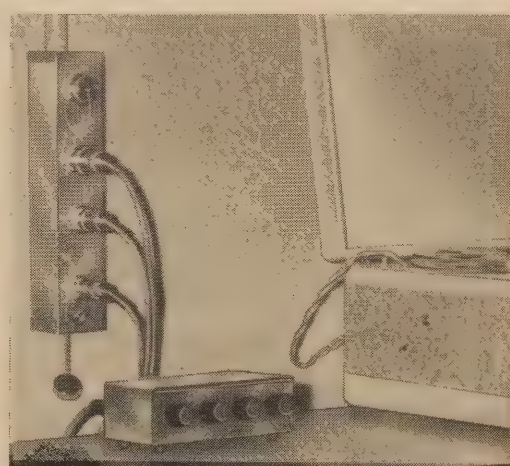


Fig. 5 (above)—Internal view of transistor mixer shows mike transformers mounted between input jacks — two more, mounted at right angles behind these, are not visible. These transformers are the ones originally in mike housings.

Fig. 6 (right)—Cable termination box for low-impedance mike system. Connectors have screw caps.



test Compactrons on your checker

This simple adapter, used with the data in the table, may keep your tube tester around a few years longer

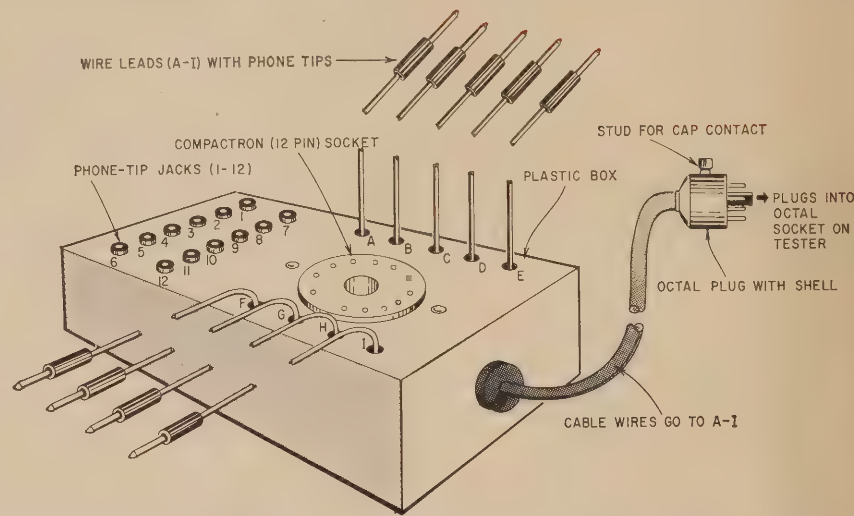
By W. G. ESLICK

THIS ARTICLE MAY KEEP YOUR TUBE checker around a few years longer, even if it doesn't have a compactron socket. The adapter shown at right, with some information on basing and characteristics of compactrons, will let you check them on any *free-point tester*—the type with only one of each kind of socket, set up with switches as needed according to information on a chart.

Make an adapter plug from the base of an old octal tube. Put a stud or some other convenient connecting point on the side as a grid-cap terminal. You now have a plug with nine contacts. Make a 9-wire flexible cable to run from this plug to a small plastic or aluminum box.

The box contains a single 12-pin compactron socket, 12 phone-tip jacks and 9 short wires with phone tips. The tip jacks are connected to the compactron socket and numbered in order 1 through 12. The phone-tipped wires are connected inside the box to the ends of the 9-wire cable from the adapter plug. Label them A through I to correspond with the eight octal pins plus the cap connection.

Now you have a compactron socket with nine available floating connections that can be juggled in any way with the pins and jacks so you can check any kind of tube section (triode, gated-beam pentode, etc.).



Pictorial of author's adapter. You may be able to dig some parts out of the junkbox, so use the layout that suits you best.

Setting up

First "break" each compactron into its prototype parts. For example, a 6AL11 compactron is a 6DT6 FM detector pentode plus 6AQ5 audio output pentode. [The compactron directory published with this article gives you such information for every compactron made up to press date.—*Editor*] Except for the heater (always connected to pins 1 and 12 in present-day compactrons), the two sections are completely independent. Because of that, you could check the 6AL11 by setting up your tube tester once for a 6DT6 and then for a 6AQ5. But since there is no socket in your checker for it, you need the adapter.

That is why you need a free-point tester. *All sockets in such testers are interconnected, but no socket is set up for a particular tube type until switches are set according to a tube data chart.*

For simplicity, then, we make up our compactron adapter to plug only

Condensed Compactron Specifications

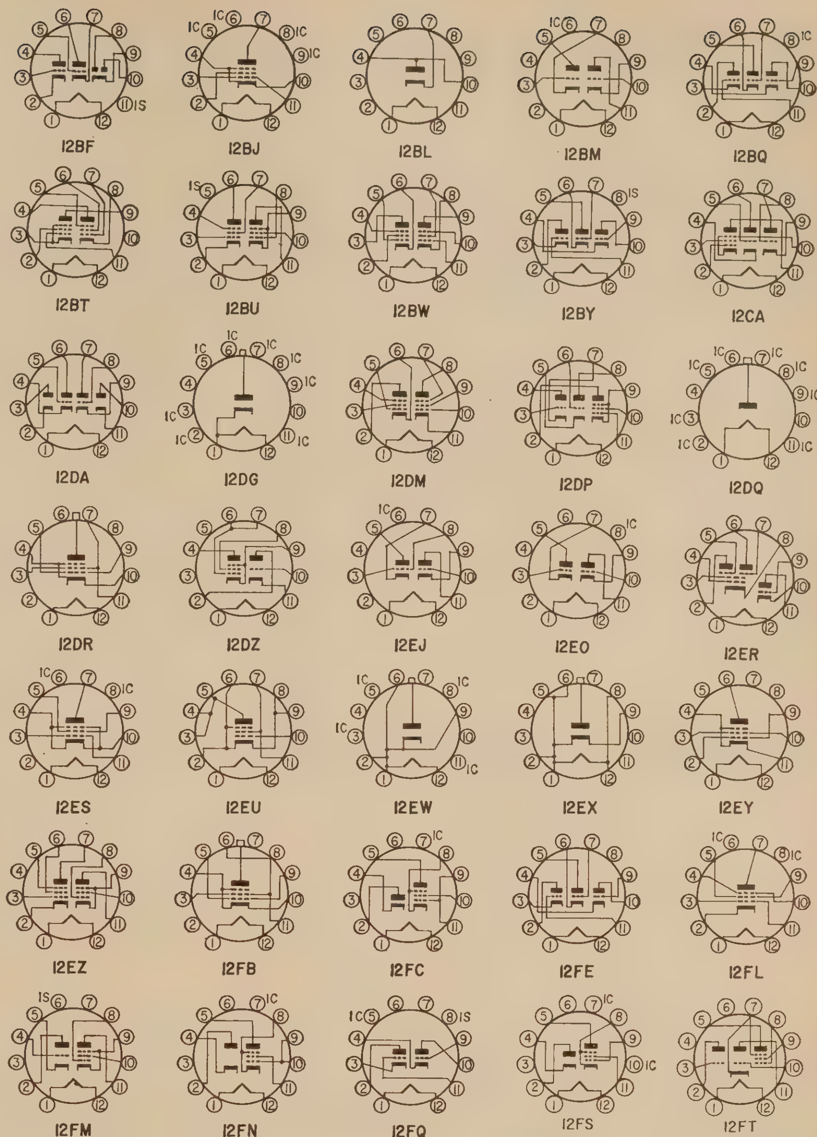
Type	Description	Characteristics Similar to	Basing	Heater Volts	Heater Amps
1AD2	Hv diode	1J3 high-voltage rect.	12DQ	1.25	0.2
2AH2	Hv diode	3A3 high-voltage rect.	12DG	2.5	0.3
2AS2	Hv diode	2AH2 high-voltage rect.	12EW	2.5	0.33
3AT2	Hv diode	3A3 high-voltage rect.	12EX	3.15	0.22
4HA7	Dissimilar double triode	One 12AU7 section (pins 4 ,9, 10) plus one 12AX7 section	12FQ	4.2	0.6
6AF11	Dissimilar double triode, pentode	High-mu triode section (pins 5, 6, 8) plus 6CX8	12DP	6.3	1.05
6AG11	Duplex diode, twin triode	12AT7 twin triode plus 6BW8 diodes with separate cathodes	12DA	6.3	0.75
6AL11	Dissimilar double pentode	6DT6 (pins 2, 3, 4, 6, 7) plus 6AQ5	12BU	6.3	0.9
6AR11	Twin pentode	Two 6GM6 pentodes	12DM	6.3	0.8
6AS11	Dissimilar double triode, pentode	High-mu triode section (pins 5, 6, 8) plus 6CX8	12DP	6.3	1.05
6AV11	Triple triode	Three 12AU7 triode sections	12BY	6.3	0.6
6AX3	Diode	6AX4-GTB damping diode	12BL	6.3	1.2
6AY11	Duplex diode, twin triode	12AX7 twin triode plus 6BW8 diodes with separate cathodes	12DA	6.3	0.69
6B10	Duplex diode, twin triode	12AU7 twin triode plus 6BW8 diodes	12BF	6.3	0.6
6BA11	Triode, twin pentode	6HS8 plus medium-mu triode	12ER	6.3	0.45
6BD11	Dissimilar double triode, pentode	Medium-mu triode section (pins 3, 4, 7), high-mu triode section (pins 5, 6, 8), plus video pentode	12DP	6.3	1.05
6BE3	Diode	Damper. Max. ratings: peak inv. volts. 5,000; dc output 200 ma	12BL	6.3	1.2
6BF11	Dissimilar double pentode	6DT6 (pins 2, 3, 5, 6, 7) plus power output pentode	12EZ	6.3	1.2
6BJ3	Diode	6W4-GT damper	12BL	6.3	1.2
6C10	Triple triode	Three 12AX7 triode sections	12BQ	6.3	0.6
6D10	Triple triode	Three 12AT7 triode sections	12BY	6.3	0.45
6FJ7	Dissimilar double triode	6DN7 vert. osc. (pins 9, 10, 11) and amplifier	12BM	6.3	0.9
6FM7	Dissimilar double triode	6EA7 vert. osc. (pins 9, 10, 11) and amplifier	12EJ	6.3	1.05
6FY7	Dissimilar double triode	6DR7 vert. osc. (pins 9, 10, 11) and amplifier	12EO	6.3	1.05
6G11	Dissimilar double pentode	6DT6 (pins 2, 3, 4, 6, 7) plus 6CU5	12BU	6.3	1.2
6GE5	Beam pentode	6DQ6-B horiz. defl ampl	12BJ	6.3	1.2
6GF5	Beam pentode	6DQ6-B horiz. defl ampl	12BJ	6.3	1.2
6GV5	Beam pentode	6DQ6-B horiz. defl ampl	12DR	6.3	1.2
6GY5	Beam pentode	Horiz. defl ampl. Max ratings: plate dissipation, 18 w; dc cathode 230 ma	12DR	6.3	1.5
6HB5	Beam pentode	6GY5 horiz. defl ampl	12BJ	6.3	1.5
6HD5	Beam pentode	Horiz. defl ampl. Max ratings: plate dissipation, 24 w; dc cathode, 280 ma	12ES	6.3	2.25
6HE5	Beam pentode	6EZ5 vert defl ampl	12EY	6.3	0.8
6HF5	Beam pentode	6DQ5 horiz defl amp	12FB	6.3	2.25
6J10	Pentode, gated-beam discriminator	6BN6 plus 6AQ5 power output pentode	12BT	6.3	0.95
6J11	Twin pentode	Two 6EW6 pentodes	12BW	6.3	0.4

into the octal socket, because the socket can be "wired" (via the tester's switches) for any conceivable type of octal tube—even one that hasn't been invented yet (like our mythical "6DT6-with-an-octal-base").

Trace connections in your tester to find out what pins on the octal socket are connected to what pins on the 7-pin miniature socket when that 7-pin socket is set to check a 6DT6 (or whatever other tube you're working with). Suppose you find that the 6DT6 cathode, besides being plugged into pin 2 of the 7-pin socket, is also connected, via the tester's internal wiring, to pin 3 of the octal socket. On a drawing of the 6DT6 base diagram (or in your tube manual), mark 3 next to the cathode pin of the 6DT6.

Pin 3 of the tester's octal socket is connected through the adapter cable to phone-tipped wire C on the adapter box. If you now insert wire C into jack 2 on the box (2 being the cathode terminal for the 6DT6-like section of the 6AL11 compactron), you have made a connection between the 6AL11 in the adapter socket, and the correct tester circuit.

You can do this just as easily for all the other pins of the compactron, with the help of the directory printed here, a tube manual and a diagram of your tester. It sounds long-winded, but after you've been through it for one tube others will go faster. And you needn't do it all at once. At first, you'll be getting only a small number of compactrons each week. Each time a new one comes in, take a few minutes to make a chart or diagram for it. That way you'll build up a "tube manual" of your own without spending a tremendous amount of time in one chunk. END

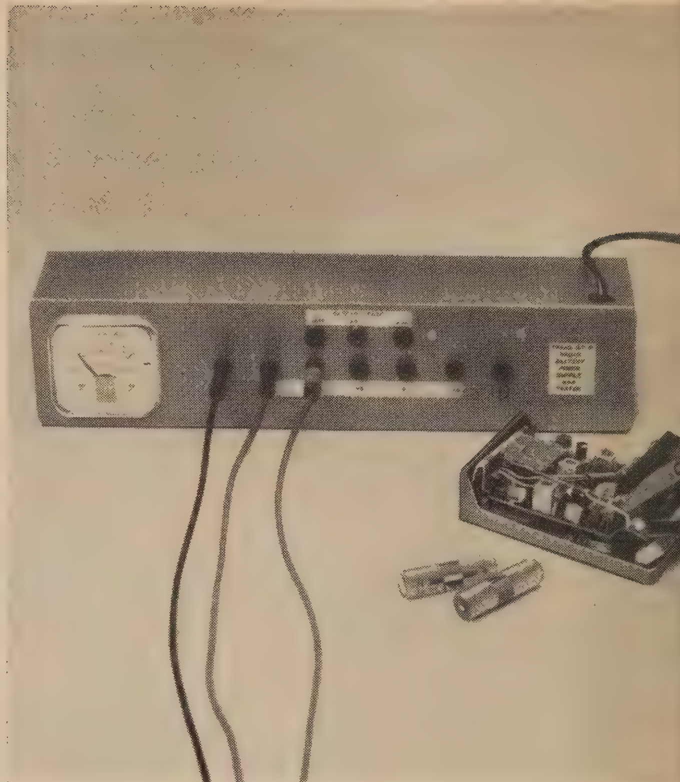


Specifications (cont'd)

Type	Description	Characteristics Similar to	Basing	Heater Volts	Heater Amps
6JZ8	Triode-pentode	6SN7 triode plus 12R5 pentode	12DZ	6.3	1.2
6K11	Three-section triode	One 12AU7 section (pins 4, 9, 10) plus two 12AX7 sections	12BY	6.3	0.6
6M11	Twin-triode, pentode	Two 12AT7 sections plus 6EW6 pentode	12CA	6.3	0.75
6Q11	Three-section triode	6K11	12BY	6.3	0.6
6T9	Triode-pentode	6AQ5 power pentode plus one 12AX7 section	12FM	6.3	0.93
6T10	Dissimilar double pentode	6AL11	12EZ	6.3	0.95
6U10	Three-section triode	One 12AX7 section (pins 5, 6, 7) plus two 12AU7 sections	12FE	6.3	0.6
8B10	Duplex diode, twin triode	6B10	12BF	8.5	0.45
10AL11	Dissimilar double pentode	6AL11	12BU	9.8	0.6
11AR11	Twin pentode	6AR11	12DM	11.2	0.45
12AL11	Dissimilar double pentode	6AL11	12BU	12.6	0.45
12AX3	Diode	6AX3	12BL	12.6	0.6
12BE3	Diode	6BE3	12BL	12.6	0.6
12BT3	Diode	6W4-GTA	12BL	12.6	0.45
12GE5	Beam pentode	6GE5	12BJ	12.6	0.6
13J10	Pentode, gated beam discriminator	6J10	12BT	13.2	0.45
15AF11	Dissimilar double triode	6AF11	12DP	14.7	0.45
15BD11	Dissimilar double triode, pentode	6BD11	12DP	14.7	0.45
15FM7	Dissimilar double triode	6FM7	12EJ	14.8	0.45
15FY7	Dissimilar double triode	6FY7	12EO	14.7	0.45
16GY5	Beam pentode	6GY5	12DR	15.8	0.6
17AX3	Diode	6AX3	12BL	16.8	0.45
17BE3	Diode	6BE3	12BL	16.8	0.45
17BF11	Dissimilar double pentode	6BF11	12EZ	16.8	0.45
17GE5	Beam pentode	6GE5	12BJ	16.8	0.45
17GV5	Beam pentode	6GV5	12DR	16.8	0.45
17JZ8	Triode-pentode	6JZ8	12DZ	16.8	0.45
21GY5	Beam pentode	6GY5	12DR	21	0.45
21HB5	Beam pentode	6HB5	12BJ	21	0.45
21HB5-A	Beam pentode	6HB5	12BJ	21.5	0.45
21HJ5	Beam pentode	6DQ5 with external connection to suppressor	12ES	21.5	0.6
22BW3	Diode	22DE4	12BL	22.4	0.45
23Z9	Dissimilar double triode, pentode	6JZ8 plus medium-mu triode (pins 7, 10 11)	12FT	23	0.45
30AG11	Duplex diode, twin triode	6AG11	12DA	30	0.15
33GT7	Diode-pentode	6GE5 plus 6AX3	12FC	33.6	0.45
33GY7	Diode-pentode	6GE5 plus 6AX3	12FN	33.6	0.45
38HE7	Diode-pentode	6HB5 plus 6BJ3	12FS	37.8	0.45
7984	Beam pentode	6146	12EU	13.5	0.58
8156	Beam pentode	Rf power ampl. 21 w output at 175 mc	12EU	13.5	0.3

ABSOLUTE MUST EQUIPMENT

BENCH SUPPLY for TRANSISTOR RADIOS



The supply is being used to substitute for a 3-volt center-tapped battery (two dry cells). Meter monitors current drain and tests batteries.

Switchless, control-less utility power supply gives good regulation and low impedance. Checks batteries under load, too.

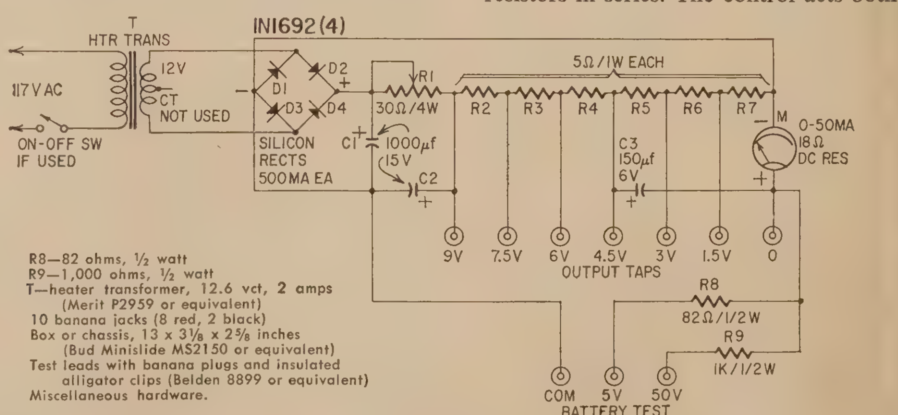
By WAYNE LEMONS

ANYONE WHO HAS SERVICED TRANSISTOR radios knows that a multiple-output metered supply is an absolute must. Automatic regulation, though perhaps desirable, is *not* absolutely essential. What is essential is that the voltage be obtained in 1.5-volt steps from more than two terminals. Many radios have taps on the battery supply at 1.5 volts. Others are tapped at 3 volts. Two-terminal supplies or even those with one 1.5-volt tap don't meet the requirements for servicing many transistor radios. Some commercial supplies that do meet the requirements are combined with other functions so that the cost may be too high for the technician who does not service many transistor radios.

This power supply meets the needs of either the casual or full-time transistor radio technician. The cost is moderate. No special parts are necessary—they should all be available at your local supply house. This supply has been used in repairing all kinds of transistor radios and has passed all tests with flying colors. Motorboating and hum are virtually nonexistent. Adjustment is easy. The calibration has never needed changing.

How it works

Four 500-ma silicon rectifiers are connected in a bridge circuit across the secondary of a 12.5-volt heater transformer. The dc output is across the 30-ohm linear control (R1) and six 5-ohm resistors in series. The control acts both



C1, C2—1,000 μf, 15 volts, electrolytic
C3—150 μf, 6 volts, electrolytic
D1, D2, D3, D4—500-ma, 100-piv silicon rectifiers (1N1692 or equivalent)
M—meter, 0–50 ma, 18 ohms dc resistance (Emico RF2C or equivalent—see text)
R1—pot, 30 ohms, 4 watts
R2, R3, R4, R5, R6, R7—5 ohms, 1 watt (or two 10-ohm ½-watt in parallel)
R8—82 ohms, ½ watt
R9—1,000 ohms, ½ watt
T—heater transformer, 12.6 vct, 2 amps (Merit P2959 or equivalent)
10 banana jacks (8 red, 2 black)
Box or chassis, 13 x 3⅛ x 2⅝ inches (Bud Minislide MS2150 or equivalent)
Test leads with banana plugs and insulated alligator clips (Belden 8899 or equivalent)
Miscellaneous hardware.

Circuit of the service power supply. On–off switch is optional: supply draws only a few watts from the ac line.

as a voltage adjustment for initial setup and as a filter resistor. It is adjusted so that 9 volts is measured at the 9-volt tap. The other taps will then automatically be in 1.5-volt steps.

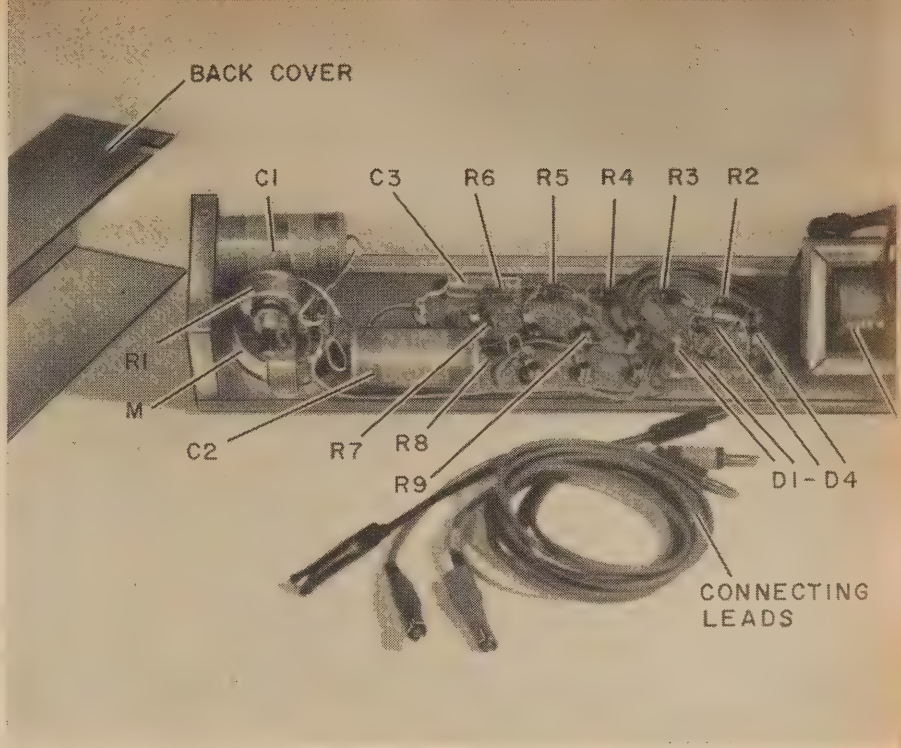
The fixed current through these bleeder resistors is 300 ma. Since this is several times the current drawn by a transistor radio, voltage regulation is more than ample for any sort of testing.

Selecting the meter is the most critical job you'll have. The meter *must* have a low dc resistance, preferably below 20 ohms. This is desirable to prevent excessive drop. For example, if the meter resistance were 100 ohms, there would be a 2-volt drop across it with just 20 ma being drawn by the radio. If the radio were a 3-volt job, this would leave only 1 volt to power the radio. Also, if the meter resistance is high, motorboating is likely since the power supply will be a common feedback path for several stages.

[Another way to reduce resistance is to use a low-reading milliammeter and shunt it. A 5-ma meter, for example, shunted by one-ninth its internal resistance, will read 50 ma with a drop of a few tenths of a volt.—*Editor*]

The 5-ohm 1-watt resistors may not be available at some supply houses. I used two 10-ohm ½-watt resistors in parallel.

The filter capacitors need not be 1,000 μf exactly. Any size from 500 μf up will do nicely, although there should be slightly less hum with the larger sizes.



Inside shot points up roomy, logical layout.

The upper three banana jacks are not necessary but we added them to use the meter for battery checking. Since the meter has a low resistance and draws high current, it is ideal for this use. It places the battery under load. (Defective batteries may read OK when not loaded.) When you test with this meter, leave the leads on for 15 seconds. If voltage reading remains at the specified terminal voltage, you can consider the battery good. As the meter is calibrated from 0 to 50, we chose two scales for testing—0 to 5 volts and 0 to 50. END

WHAT'S YOUR EQ?

Three puzzlers for the student, theoretician and practical man. Simple? Double-check your answers before you say you've solved them. If you have an interesting or unusual puzzle (with an answer) send it to us. We will pay $10 for each one accepted. We're especialy interested in service stinkers or engineering stumpers on actual electronic equipment. We get so many letters we can't answer individual ones, but we'll print the more interesting solutions—ones the original authors never thought of.

Write EQ Editor, Radio-Electronics, 154 West 14th Street, New York, N.Y. 10011

Answers to this month's puzzles are on page 53.

Untermination

Fig. 1 shows an unterminated tee network and Fig. 2 shows an unterminated pi network. Can you determine the electrical characteristic that the two networks have in common?—*K. Collins*

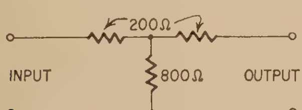


Fig.1

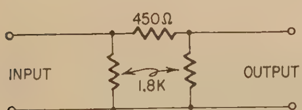
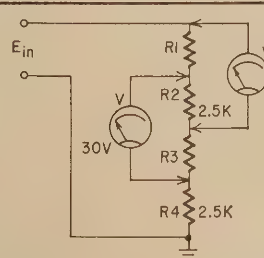


Fig.2

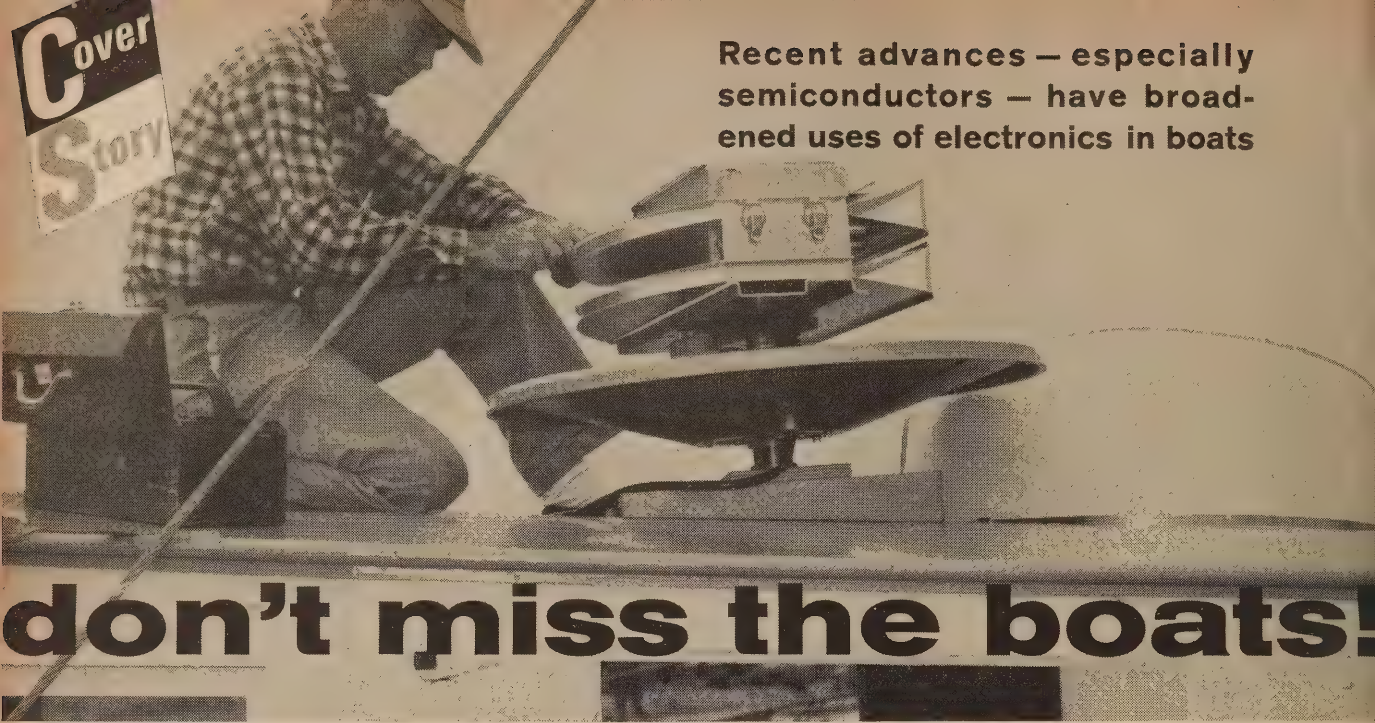
Voltage Divider

In the diagram, R2 and R4 are each 2,500 ohms. Readings taken with voltmeters (V) assumed to have infinite impedance show 70 volts across R1 plus R2, and 30 volts across R2 plus R3. What is the input voltage (E_{IN})?—*Harold J. Turner, Jr.*



Doodles

How do you produce this waveform on an oscilloscope?—*Lee H. Stanton*



Cover Story

Recent advances — especially semiconductors — have broadened uses of electronics in boats

don't miss the boats!

Trend in pleasure-boats is to lighter, smaller radars. This installation, a Raytheon 1900, uses a folded parabolic 30-inch transmitting antenna with the magnetron at the focal point to eliminate heavy, lossy, expensive waveguide. Similarly, receiving antenna has klystron at center. Entire assembly weighs 43 pounds.

By J. LEONARD LOVETT*

JUST A FEW YEARS AGO ONLY THE LARGest, most luxurious pleasure boats carried any electronic gear. Today, anything that floats is a candidate for some type of electronic equipment. An oar-powered skiff may carry a portable depth sounder to help the leisure-time fisherman find fish, and a small portable handie-talkie to communicate with his family ashore. A well equipped 40-foot cruiser may have marine radiotelephone, Citizens-band radio, depth sounder, automatic direction finder, loran receiver, radar, auto-pilot, gyro compass, TV, hi-fi!

The first and most important reason for electronic equipment on pleasure boats is safety. The second is to obtain greater enjoyment from the boat.

Many of the electronic devices on pleasure boats today are designed primarily as aids to navigation — radars, depth sounders, direction finders and loran receivers that help the boatman to locate his position. Navigational gear helps keep a boat owner out of trouble, but probably the most popular single item on a pleasure boat is the radiotelephone. An important safety device, it has few preventive powers. It merely allows the boat owner to call for assistance.

Most marine radiotelephones operate between 2 and 3 mc. Because of the limited number of channels available and the large and increasing number of radio-equipped boats, these frequencies are becoming extremely congested. The boating public and the commercial marine users of these frequencies, as well as the FCC, are deeply concerned. Because of increasing requirements on all radio services, it is unlikely that any substantial relief can be obtained by assigning additional frequencies for marine use. The only relief is to utilize the available frequencies better and eventually to use modern techniques, such as single sideband, which will effectively double the number of channels.

Vhf channels are entirely satisfactory for short-range communication, and in many respects are more desirable than the 2–3-mc band. On vhf, frequency modulation is used, which makes communication much less subject to man-generated noise (from sparkplugs, generators, voltage regulators). The frequencies are limited to line-of-sight communication but, in many cases, around heavy boating centers, such a range is entirely adequate.

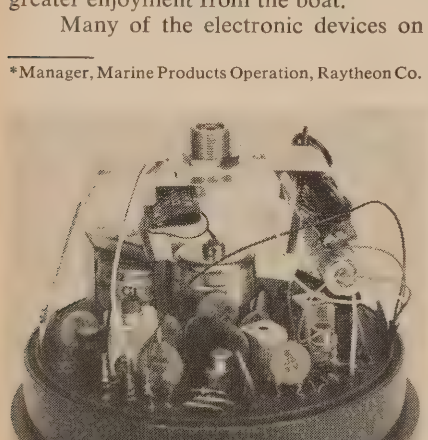
Right now, very little use is being made of the marine vhf. The equipment is more expensive than medium-frequency gear and, because few people are using the frequencies, this discourages others from using them for emergency communication. The vhf marine safety and calling frequency of 158.6 mc is monitored by the telephone company and to some extent by the Coast Guard. Unfortunately, it is not yet being monitored to any extent by other pleasure-boat users.

As the boat population increases, more and more use will have to be made of the vhf channels. Prices are dropping, and the pressure of interference in the 2–3-mc band may force the boater into vhf.

If all the AM transmitters in the present 2–3-mc band could be switched to single sideband, it would double the number of available channels. Because standards for this particular service have not yet been adopted by the FCC, it is unlikely that this changeover can be completed in less than 10 to 15 years.

In recent years great changes and improvements have taken place in small radiotelephones. They have become smaller and lighter, they consume less power, cost less money and have become more dependable. Additional improvements and refinements will come.

Probably the biggest change is the introduction of semiconductor components. Transistors are being used extensively in receiver sections of radiotelephones. They still have some disadvantages. Transistors, being low-voltage



Transistor depth sounder, face down, shows synchronous motor in center. Circuitry on printed-circuit board surrounds the motor.

*Manager, Marine Products Operation, Raytheon Co.

Gas detectors like this one use sensing unit (at left) and control unit, which carries warning light. Alarm light flashes when gas-fume accumulations in bilges or engine spaces reaches dangerous proportions.

low-impedance devices, are much more susceptible to noise pickup from the operating line than vacuum tubes. Transistors will not stand overvoltage as will vacuum tubes, and design techniques are more exacting. Some earlier transistor marine receivers left much to be desired in the way of overloading, crossmodulation and agc dynamic range. Today, excellent transistor receivers are available. The noise problem is handled by adequate line filtering. Because of the low power consumption, it is practical to build in voltage regulation so the overall receiver will actually handle wider voltage excursions than a comparable tube receiver.

Tubeless ship-to-shore radio

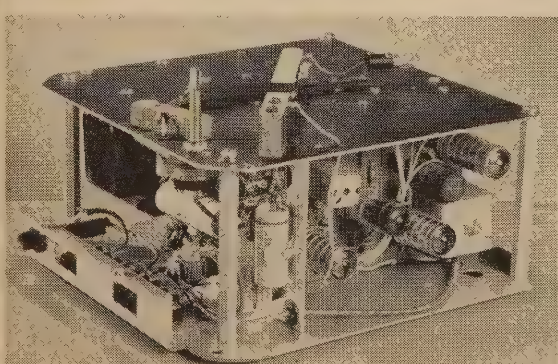
Until very recently, transistors with sufficient power-handling capabilities at high frequencies for transmitter use were too expensive for commercial applications. This has now changed, and Raytheon introduced this year the first new all-transistor radiotelephone. The device was at first very difficult to modulate 100%—new circuitry on which patents have been applied for had to be developed.

Probably the most important advantage to the boat owner is that there is absolutely no standby current and zero warmup time. Press the push-to-talk button on the microphone, and you are on the air. Without heater drain, transmitter efficiency is extremely high and it is practical to install a 45-watt radio on even a small outboard craft with a minimum battery installation. Another advantage, of course, is that the size of the entire package is reduced, making it compact and convenient to install on any size vessel. Not quite so obvious to the average boatman, there is no voltage inside the receiver or transmitter higher than 24, with the exception of the rf output itself. This makes for long, troublefree life in marine service, and for less danger from accidental shock.

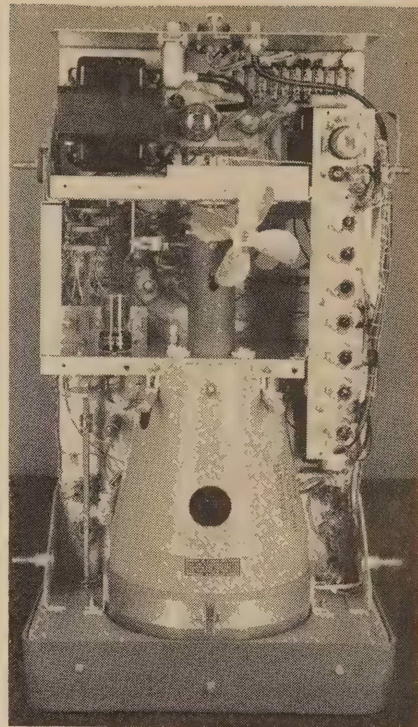
Another important advance in marine radiotelephones is the use of instant-heating tubes. In higher-powered sets, transistors are still too expensive for commercial use. However, Raytheon has recently introduced a 150-watt set all-transistor except for the final amplifier tubes. These are instant-heating, so the filaments are not lit until the microphone's push-to-talk button is pressed. This cuts down standby current drain and, more important to the user, the radio is always ready for instant transmission.

CB use expanding

CB equipment is being used more and more on pleasure craft. Much of the equipment is inexpensive compared to other types of radio gear. It is compact, requires a minimum amount of power and, in many cases, is installed in addition to the marine radiotelephone. It is most useful in handling races, exchanging fishing information and, on lakes not covered by regular emergency services, serves as the only link with shore. As time goes on more and more of this equipment will be available fully transistorized.



Indicating depth sounder, removed from case and lying on its back. Rotating arm, top center, carries small neon bulb which is flashed by outgoing signal and again by returning echo.



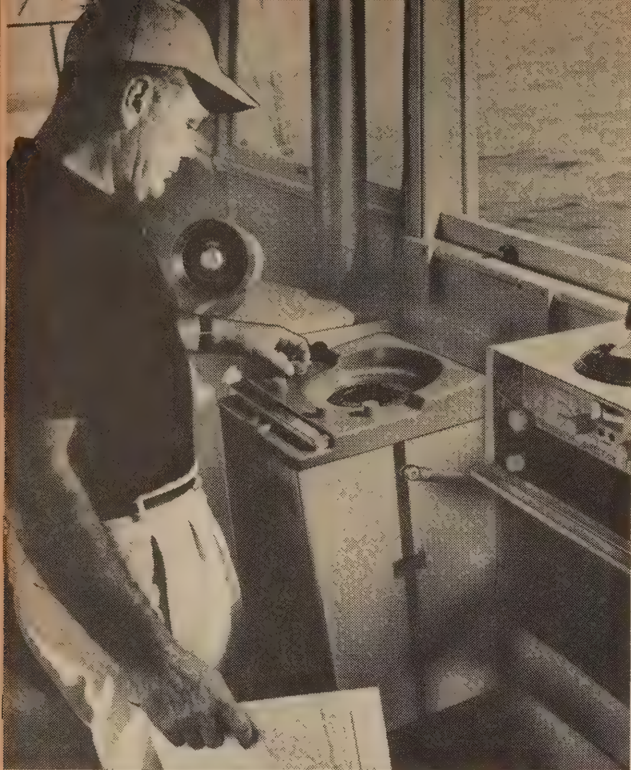
Internal view of Raytheon model 1700 compact radar. All tubes are accessible from top of chassis.

New dual depth sounder

The equipment that has had probably the greatest growth in popularity in the last few years is the small depth sounder. During periods of limited visibility or while cruising in unfamiliar waters, a man wants to know where the nearest land is (usually straight down). The depth sounder gives this information quickly, accurately and inexpensively.

Not too many years ago the cheapest depth sounder cost about $3,000 and required about 500 watts of power. Today, depth sounders are available from approximately $100. All-transistor models draw as little as 1/10 amp from a 12-volt battery.

Besides being an excellent navigation aid, especially for the novice, the depth sounder is a real fisherman's friend. It not only points out bottom contours and the most likely places to find fish, it actually detects fish beneath the surface. The recorder type is the easiest to use for fish detection, but has not been as popular as the red-light indicators type because of cost. Introduced at the National Motor Boat Show in New York this January was a combination red-light indicator and recorder in the $200 class. This is less than previous prices for a recorder alone. This recorder operates from zero to 240 feet in two phases, arranged so that no switching is required. When the depth exceeds 120 feet, the second phase automatically takes over. The recorder can be turned off when a record is not required, conserving paper.



This radar, a Raytheon 1700, has a range of 12 miles. Targets are presented on 7-inch CRT.

The recorder and red light can be operated simultaneously so that approximate depths can be noted from the red light and then exact measurements taken from the recorder to compare with the chart for navigational purposes.

A depth sounder is just as necessary on a boat as a speedometer is on an automobile. Evenutally depth sounders will be standard equipment, probably built right into the instrument panel just the same as a tachometer or an oil pressure gauge.

Compact radar

One of the most spectacular electronic aids to navigation to come out of World War II was the surface search radar. It was immediately adopted by merchant ships, but it has taken quite a few years to develop equipment for pleasure boats. Size, weight, power consumption and – probably most important – cost, made World War II type radar entirely impractical for the small craft. Today, good-looking, compact, highly reliable radars are available in the $2,000 to $2,500 price range for cruisers as small as 30 feet. Power consumption has been reduced to the point where it is practical to operate radars from a 12-volt battery system. Radar, of course, is the ideal device for short-range navigation, piloting and collision prevention. Completely self-contained, it does not depend on any stations ashore or on other vessels. You can pick out land, channels, buoys and other vessels with a minimum amount of training.

Pinpoint positioning off shore

Another World War II development becoming popular with offshore cruising and sailing enthusiasts is the loran system. Again transistors have reduced size, cost and power consumption. Modern commercial sets with direct-reading counters are much easier to use than the original wartime gear. The newer sets can also receive both loran A and loran C. Loran C is a fairly recent development. Transmitting on 100 kc, it gives longer ranges and greater accuracy than loran A, which operates at 2,000 kc. Loran C is now operational in the North Atlantic, North Pacific, the Arctic Oceans, the Mediterranean and the Bering Sea. It is expected that combination loran A–loran C receivers will become increasingly popular on large ocean-going yachts.

Radio direction finders have always found wide use on small craft. Today the radio direction finders are available to fit every possible application and everyone's pocketbook. They range all the way from small portable units selling in the neighborhood of $100 to an automatic model for approximately $1,300.

The small portable units, though not as accurate as the larger automatic fixed installations, are extremely valuable navigation aids. They can also be used to listen in on weather broadcasts, to monitor the distress frequency of 2,182 kc, and to receive entertainment broadcasts. Small and light, they contain their own batteries so they can be carried on even the smallest vessel. The larger automatic direction finders have the distinct advantage that they can give instantaneous bearings.

The automatic pilot certainly adds to the enjoyment of boating, especially on long trips. It relieves the long, monotonous hours at the helm. It frees the helmsman so he can devote more attention to lookout rather than having to concentrate on watching the compass. The automatic pilot normally steers a more accurate course than a human helmsman, saving both time and fuel. Again, transistors are finding ever increasing use in the control circuits of automatic pilots.

Transistors open new areas

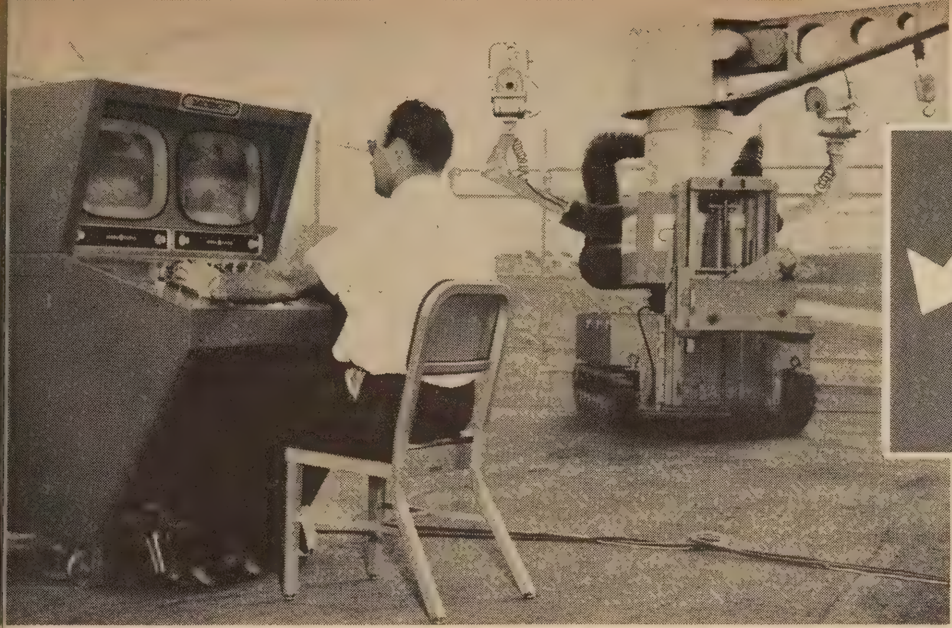
The transistor is one of the greatest technological changes of the last few years and has materially affected the design of marine electronic equipment. Its development, and the increasing use of marine electronic equipment has encouraged manufacturers to spend substantial sums on engineering and tooling new products. Even though marine electronic equipment is still not mass-produced in the same sense that domestic radios and television sets are, quantities are now high enough that manufacturers can afford to do some rather extensive tooling, giving the customer a much better dollar's worth. Present trends of reducing size, weight and power consumption will continue. In some cases there will be price reductions but, by and large, the economies made by heavier tooling are now just about being overtaken by the increasing costs of manufacture.

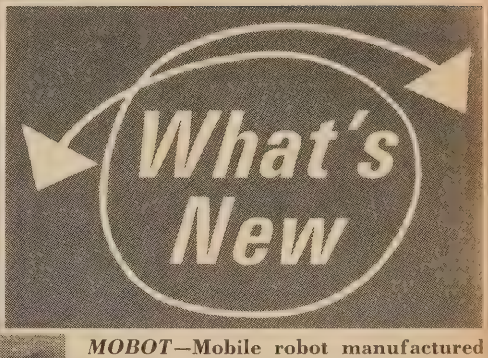
Televised radar

One of the foremost of new systems in development or under consideration is the Ratan system, sponsored by the US Coast Guard and developed by Raytheon. This consists of a shore-based surveillance radar of extremely high definition. The output of the radar is converted on a scan converter to a standard television raster and is then transmitted over the surveyed area by a uhf television transmitter.

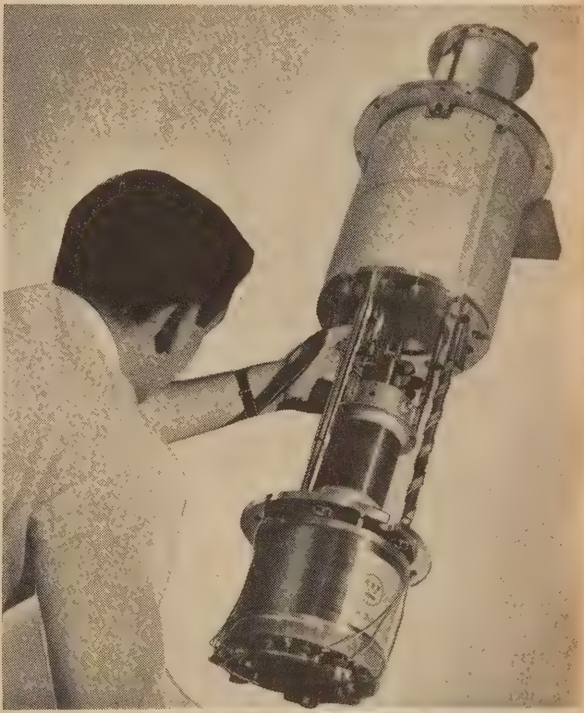
Any vessel, large or small, within the range of the transmitter can be equipped with an ordinary uhf television receiver and get a radar picture of all vessels, including his own, in the area. Because of storage time in the scan converter, moving vessels show a trail after the vessel, indicating their course. This system has been in experimental operation in New York Harbor for two years with excellent results. If it is adopted for the major harbors of the US, it would mean that a small craft would have to be equipped with only a television receiver to get a first-class radar picture.

Because of the congestion on marine frequencies, we will no doubt see considerable change over the next few years, primarily in the greater use of Citizens-band frequencies in the 27-mc range and vhf frequencies in the 150 to 160-mc range. These changes will come about rather slowly at first, but I think we can expect to see a fairly heavy drift to vhf within the next 3 to 5 years. END

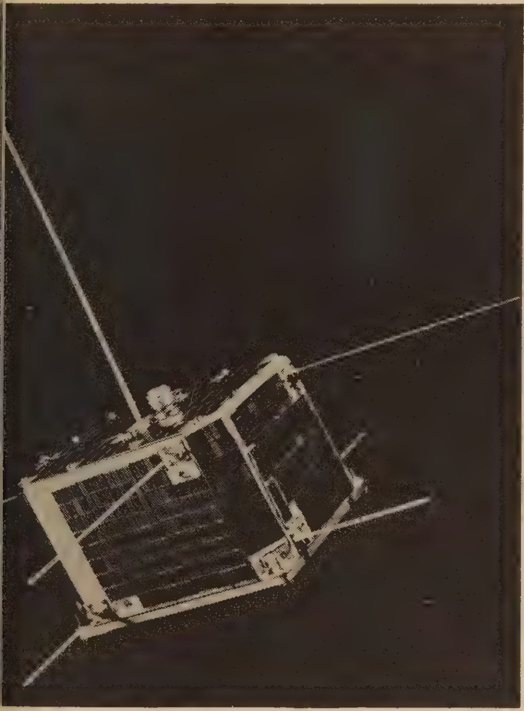




MOBOT—Mobile robot manufactured by Hughes Aircraft Co. performs emergency or cleanup operations in nuclear reactor environments too hazardous for man. Weighing about 7,000 pounds, "Mobot" is controlled remotely from console at left via 500-foot cable. TV screens on console show what Mobot's TV-camera eyes are seeing.

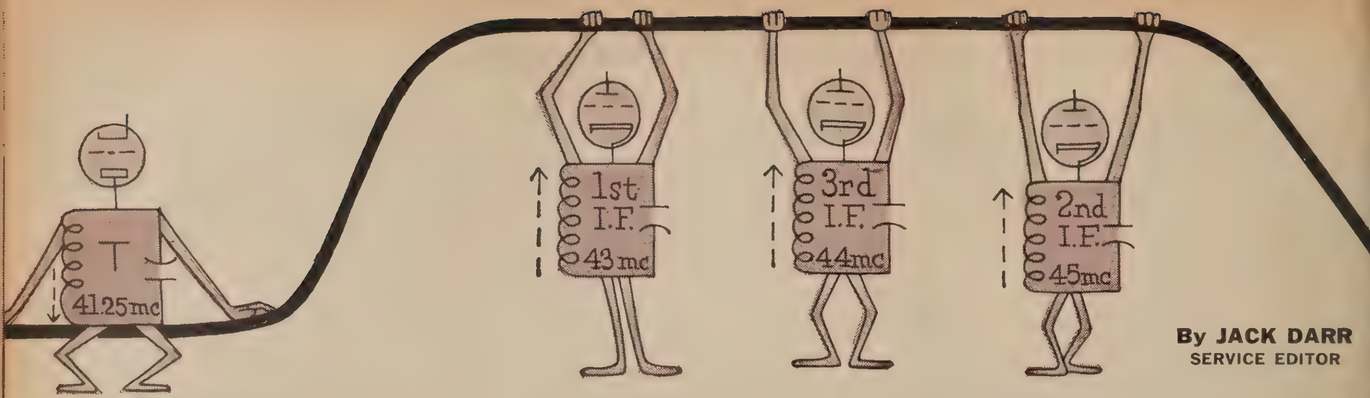


100,000-GAUSS SUPERCONDUCTING MAGNET is operated from auto storage battery, which is disconnected once magnet is functioning. First of its kind in the world, magnet can be cycled repeatedly from zero to full field strength without damage, a requirement in many tests. Coil contains some 20 miles of niobium-zirconium wire and wire of new superconducting alloy. It is operated in vessel of liquid helium at −452°F.



MAP-MAKER SATELLITE is expected to help US scientists get truer picture of earth's shape. Army satellite, developed by International Telephone & Telegraph Corp., is designed to work with network of ground stations to provide more accurate data on locations of continents, islands, other landmarks. It may also give important data on shape of earth itself—thought to be more egg-like than spherical.

VOICE COMMUNICATION VIA LASER over 3.3-mile path between International Telephone & Telegraph building and Lincoln Tower building in downtown Ft. Wayne, Ind. Helium-neon laser is focused and directed through Brewster windows and confocal optics, with collimator and 2-inch aperture lens. Receiver, shown here, is 8-inch cassegranian telescope with ITT-Industrial Labs-developed multiplier phototube. System bandwidth is 10 kc.



By JACK DARR
SERVICE EDITOR

Tuned circuits hold up response curve at certain frequencies. Some, like trap circuit T, hold down signals we don't want.

in and around the video i.f.

Video i.f. stages run pretty true to type. How they work, how to track down troubles and fix them

VIDEO I.F. TROUBLES CAN CONFUSE EVEN the skilled technician. As usual, a couple of other things can cause the same symptoms! So let's take a good look at video i.f.—find out how to isolate trouble in it and fix it. This is *not* complicated. A couple of tests with only simple test equipment will give you the answer.

First, this word of caution: for first checks, *never* touch the alignment adjustments! Leave them strictly alone—they cannot "suddenly" cause a loss of picture or sound like a bad tube, resistor, etc. Wait until everything else is done, and *then* do your aligning. At least 95% of alignment jobs today are necessary because somebody got a little overeager with a little screwdriver!

The video i.f. is a wide-band amplifier. It may have from two to four stages. It must pass a band of frequencies at least 4.5 mc wide, more than four times the width of the whole AM broadcast band. So we need some special circuits. Older sets used broad-band (overcoupled) transformers. This wasn't too good, so the later sets use *stagger-tuned* i.f. stages. Each little tuned circuit has its own job, to hold up the response curve at a certain frequency, as in the head cartoon. These are each pretty wide-band, sometimes with resistors shunted across the coils to flatten the response. Knocks the heck out of the gain, but they cover more territory.

Traps

To make the curve shape right and get rid of interference from adjacent channels, we use another kind of tuned circuit. This one pushes *down* instead of up. It's called a *trap* circuit, and it takes out signals we don't want, like the sound carrier from the channel below. The cartoon in the head shows only four tuned circuits, but there may be seven or eight. Trap circuits are shown in Fig. 1 as TR1, TR2 and TR3.

Video i.f. amplifier troubles

What happens when we get trouble in these circuits? Same thing as with any other amplifier, video, audio or what-not. The signal won't go through! The standard symptom for video i.f. trouble is a nice clean white screen—no snow, no picture and usually no sound. This kind of trouble also could be output stage, so we need a way to find out for sure.

So, let's cut 'em down: disconnect the tuner and override the agc with a bias box. This is nothing more than a battery with a variable resistor across it. Connect the positive terminal to ground, and the negative to the point indicated in the instructions. This will usually be the i.f. agc bus or the "bottom" of the grid resistors. The voltage will be stated—usually something like 2–3 volts negative.

Now, we've got nothing but the video i.f. to check.

Fig. 1 shows a typical video system. The simplest check is signal injection to the video amplifier. All we need is an AM rf signal generator. Feed an audio-only signal at 400 cycles or so into the video output tube grid, at point A. If the video output is OK, you'll see the black bars (Fig. 2).

Next, feed the signal to the grid of the first video i.f. tube, point B in Fig. 1. Set for modulated rf output, near the picture carrier: 25.75 in 20-mc. sets, 45.75 mc in 40-mc sets. If the signal is going through the video i.f., you'll see the same black bars on the screen, from the audio modulation.

If the bars are clear and dark, good; this usually means enough video i.f. gain. If they're pale and weak, you're losing something in the video i.f. Go back to the video detector input, and feed the signal into each grid in turn, working from the video detector back toward the tuner. The bars should get blacker and sharper each time you go past a stage. Suggestion: practice this on a couple of TV sets that are working, so you'll know about what to expect.

Make a note of the signal generator output attenuator setting. Trying this on a good TV set will tell you how much output will be needed (average) to make good clear bars. You'll notice some

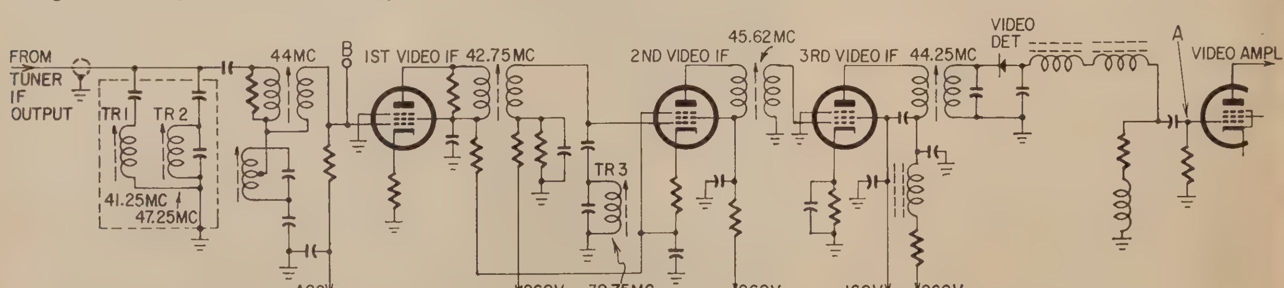


Fig. 1—Complete video amplifier system, fairly typical, shows circuit features, test points, etc.

shading on the edge of each bar: this is because the audio modulation is a sine wave. If it were a square wave, the edges would be sharp.

In-the-home testing

Checking video i.f. troubles in the home, without the shop test equipment, boils down to changing all tubes, and checking for proper setting of the agc control. Change the video output tube at this time, to be sure. Check the tuner tubes, too. Plate and screen voltages can be measured from above the chassis with a test adapter.

Be sure to check plate and screen-grid voltages, since these are pretty critical. They ought to be within about 5%. Watch out for the sets which get the video i.f. B-plus voltage from a *stacked* B-supply via the audio output tube cathode. Audio troubles can cause fake video i.f. trouble if this voltage isn't right. It's usually about 130–150. If you get "funny effects," check this supply line for poor filtering, with a scope and low-capacitance probe. Try adding extra filter capacitors across it, just to be sure.

You'll also find the first and second video i.f. tubes stacked in many circuits. This circuit is used in Fig. 1, and Fig. 3 shows a breakdown of how it works. In Fig. 1, you see the plate voltages on each stage as they read from ground or B-minus. In many schematics, you'll find the voltages on the top stage given with a dot, square or triangle alongside the figures. The list of symbols on the schematic shows that these voltages are read from the cathode of that tube itself. Connect the negative lead of the vtvm to the cathode, which of course gives you the actual voltage on the tube, since the cathode is always the reference point.

Alignment

Video i.f.'s can be aligned with an AM rf signal generator, a dc vtvm and a bias box. All schematics give full alignment instructions.

First, we need fixed bias on the video i.f., to kep the agc from affecting our results. So we supply a fixed bias from a bias box.

We need to feed our signal into the first video i.f. tube grid, but we mustn't connect directly to it. That would detune the circuit. So, we use as loose a coupling as we can get. Good trick: take a short piece of RG-59/U coax, put a plug on it to fit your signal generator, and strip off the jacket and shield for about an inch on the other end. Leave the inner insulation, and make a hook out of the wire. Now, this can be hooked over the grid lead, or even the plate lead, to give you plenty of signal coupling.

If the i.f.'s are badly detuned, hook the direct output of the signal generator to the 1st i.f. grid. Roughly tune all circuits, *then* loosen the coupling and finish the job.

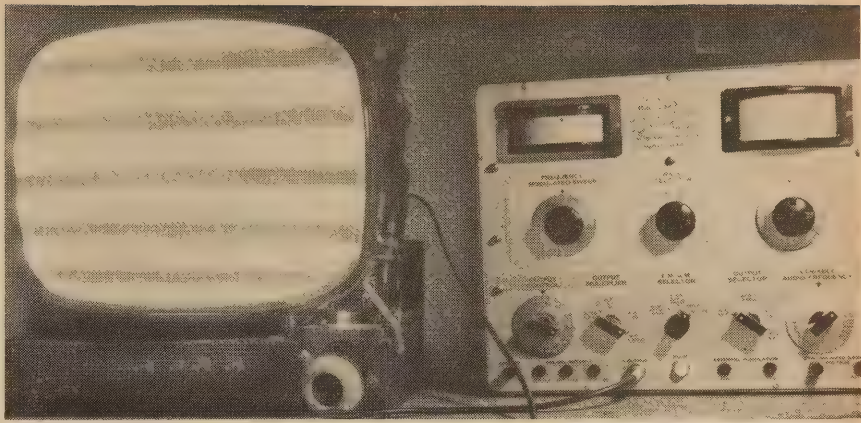


Fig. 2—An amplitude-modulated signal at the video intermediate frequency, fed into the video i.f. stages, makes alternate black and white bars on the screen. Useful for signal tracing and rough gain checks.

Locating the adjustments

Look up each alignment adjustment in the service data. There will be a layout or photograph of the chassis in Sams Photofacts, showing you exactly where each adjustment is. Hint: when you find one, mark it on the chassis with a soft pencil, together with the frequency it's to be aligned at. This saves a lot of time. For trap adjustments, mark the frequency and then put a very distinct "T" beside each one.

To tell when you have each stage peaked, connect a dc vtvm to the video detector output, on a low scale, set for negative volts. Now, when we tune a circuit, maximum negative voltage means peak output. If the meter goes off the 3-volt scale, or whatever yours has in that department, cut down the generator output or loosen the coupling a little. This is exactly the procedure used to align radio receivers: the rectified rf signal shows your signal output!

After aligning the video i.f.'s, move the signal generator to the tuner. (The mixer plate circuit is actually a part of the video i.f.) Lift the shield from the mixer tube and slip a piece of tape or paper in it so that it won't ground to chassis. Now connect the signal generator output to the floating shield and adjust the input i.f. coil or transformer, usually a physical part of the tuner.

Follow trap-setting adjustments very carefully, since a trap scooted over too far can cause all kinds of troubles. Traps are set with exactly the same test equipment hookup, but they are adjusted for a dip—minimum reading instead of maximum. Increase the signal generator output to be sure you've got them set on the bottom of the dip.

Signal generator calibration

The accuracy of the signal generator is very important, especially when setting traps and the adjustments near the edge of the band (the picture and sound carriers, for instance). Check your rf generator against WWV.

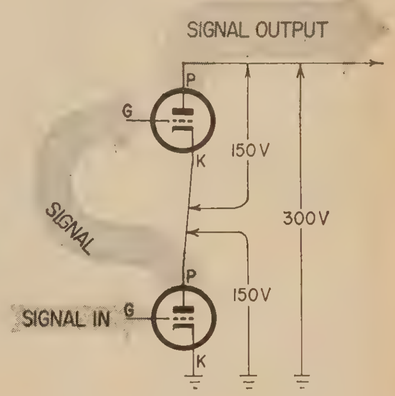


*Fig. 3—Basic circuit of "stacked" video i.f. stages. Stages are in series for dc across total supply voltage. Signal path is conventional cas*cade, *not cas*code!

Warm up the generator. Tune its dial to 20 mc. On a communications receiver capable of going to 40 mc, tune in WWV on their its 20-mc signal. Zero-beat the signal generator with this signal. Next, tune the receiver to 40 mc and tune in the second harmonic of the signal generator, for maximum output. Finally, leave the receiver dial alone, and tune the *generator* to 40 mc, for maximum output on the receiver. Note the amount of dial error, if any, and write it down. When setting up 40-mc i.f.'s, use this amount of correction in your dial settings, and you'll be very close.

If your communications receiver won't go to 40 mc, use the 10-mc WWV signal, zero-beat the signal generator on it, with the output set pretty high, and then use the fourth harmonic of the generator instead of the second. *Note:* the attenuators on some generators affect the *frequency*. While the generator is zero-beat with WWV, try changing the output level. This should *not* change the zero-beat at all. If it does, set the attenuator for any "average" output level, zero-beat it, then leave the attenuator alone. Adjust signal level from then on by loosening or tightening coupling. END

Extra light just where you need it — without connecting cords of any kind

Bright Genie the slave of light

The Bright Genie slave stands only 10 inches high and is completely self-contained. Hooded phototube on top rotates so it can be pointed at main camera-synced flash.

By R. L. WINKLEPLECK

IN THE PHOTOGRAPHER'S book, a "slave" is a flash unit that operates in unison with the flash on the camera, without interconnecting cords. The burst of bright light from the flash on the camera activates the remote unit. In an electronic flash, slave or otherwise, the flash of light is produced directly by an electric discharge through a tube of rare gases rather than by burning magnesium or similar material in the familiar flashbulb. Electronic flash has taken the country by storm and Bright Genie is its logical companion.

Bright Genie can be constructed for less than the cost of similar commercial units—much less if some of the parts from an old flash can be salvaged. But its primary justification is that it outperforms most commercial units in several important ways. Its power converter is amazingly efficient. Four D-cells provide many, many, full-intensity flashes, and its monitor circuit permits keeping it ready for instant action over long periods without exhausting the batteries unduly. This same monitor circuit holds the output voltage constant, even as the batteries age, to assure uniform exposures. The thyratron firing circuit is an improved version used in only one commercial flash outfit. It provides a prompt and reliable response which was never achieved in the older trigger-tube circuits.

The energy output *actually* exceeds 46 watt-seconds. This isn't an advertising claim. It will stand up under investigation much better than some of the so-called bargain units offered to the public. The light output can be inincreased by using a Zener diode with a higher Zener voltage. That will produce a higher regulated voltage. Or you can add a second energy-storage capacitor in parallel with the first. These two modifications, made singly or together, will increase the light output but will reduce the number of flashes produced with one set of batteries. Choose the combination best suited to your requirements.

There's another important advantage to building your own: photographers and electronics hobbyists are constantly modifying purchased equipment to suit their exact requirements better. By starting from scratch, you can follow the design suggestions offered here or make as many changes as you like to produce the perfect slave flash.

Construction details

Bright Genie was built into a 3½ x 6 x 8-inch aluminum Minibox. The reflector was salvaged from an old flash bulb outfit with the socket removed and a rectangular block of plastic cemented in its place. The reflector was sprayed with gloss white, and the flash tube mounted in holes in the plastic block in the position formerly occupied by the bulb, to assure even light distribution. Most of the circuit components are mounted on a piece of punched circuit board. After the wiring is completed, this miniature chassis is screwed to the flash-tube mounting block which extends through the back of the reflector.

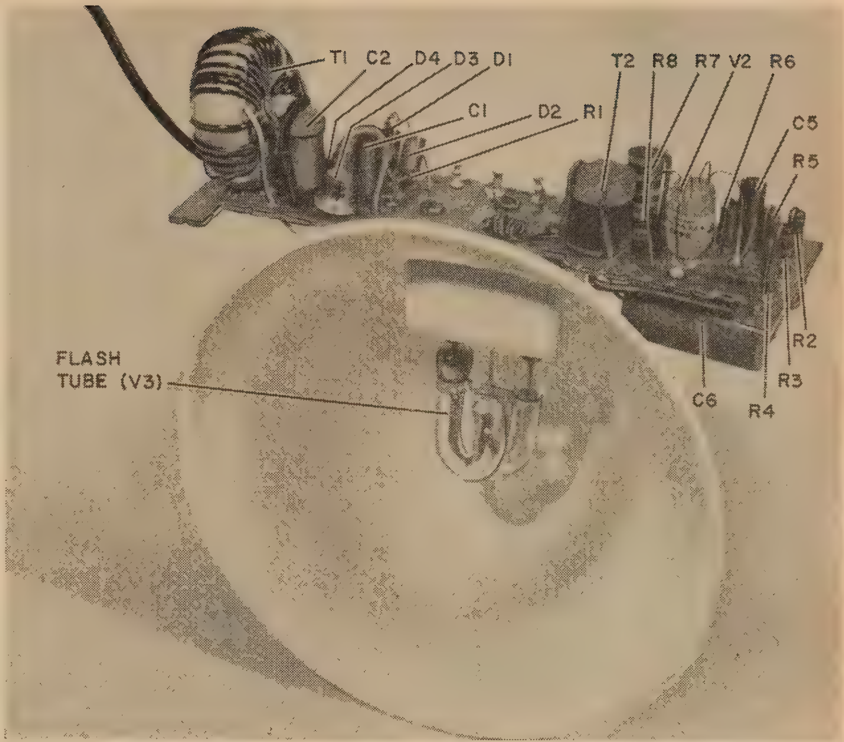
The entire assembly is fastened with four machine screws behind a circular cutout in the front of the Minibox. A thin sheet of clear plastic protects the flash tube from accidental breakage.

Two strips of scrap aluminum hold the big energy-storage capacitor in place. A battery holder mounts on each aluminum strip. A third piece of aluminum connecting the other two carries the power transistor and acts as a heat sink. The octal socket for the phototube is held in place but allowed to rotate by sandwiching its metal mounting flange between the top of the Minibox and still another piece of scrap aluminum. The shield for the phototube is an old electrolytic capacitor can which was cleaned out and has a window cut in it. A heavier square of aluminum is fastened to the bottom of the box and drilled and tapped to accept a standard ¼-inch tripod screw. The neon ready light is held in place with a rubber grommet. These construction details are important only as suggestions. Many equally satisfactory arrangements are possible.

The power converter

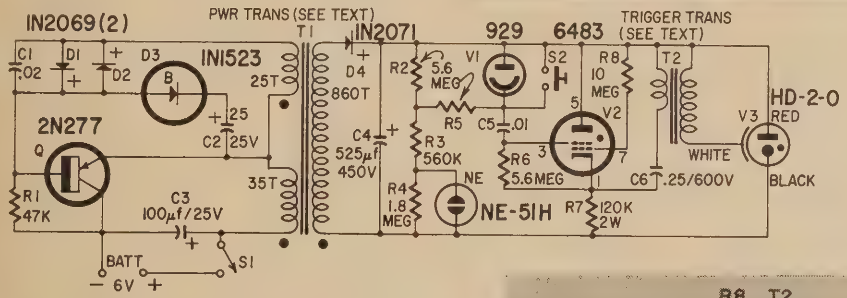
The circuit gets special attention. Its use, in whole or in part, isn't necessarily confined to this particular application. The power supply, for instance, could be incorporated in an old flash unit to update it, or it could be used wherever a power converter with a well regulated output is needed. Not original with me, it received only brief mention quite some time ago in one of the technical publications and deserves much wider distribution.

Basically, the power converter is a flyback oscillator. It's free-running until



Flash out of its case. Reflector comes from old bulb-type flash unit, modified as described in text.

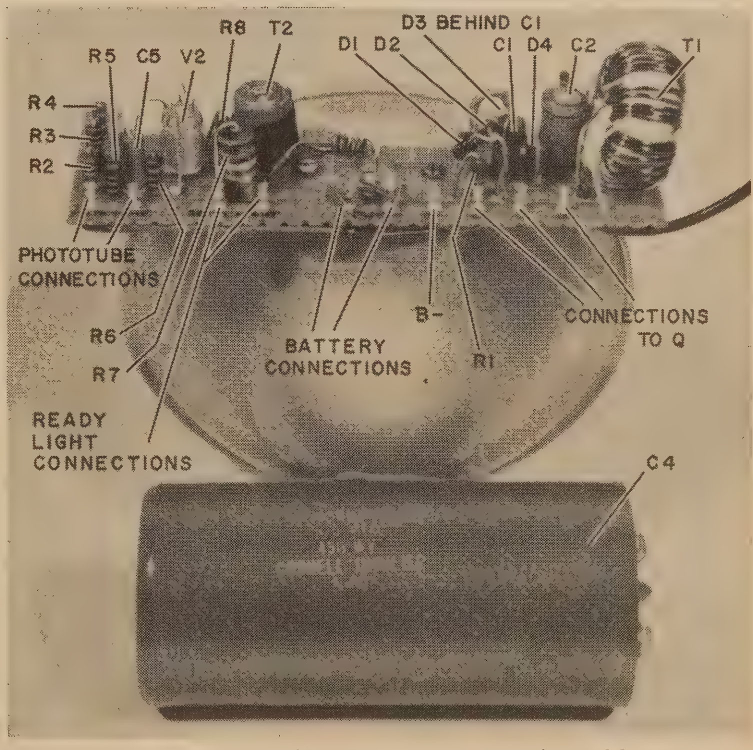
C1—.02 μf
C2—25 μf, 25 volts, electrolytic
C3—100 μf, 25 volts, electrolytic
C4—525 μf, 450 volts, electroyltic (special photoflash capacitor—Sprague, Cornell-Dubilier, etc.)
C5—.01 μf, 200 volts
C6—0.25 μf, 600 volts
D1, D2—200-piv silicon rectifiers (1N2069 or equivalent)
D3—9-v Zener diode (International Rectifier 1N1523 or equivalent)
D4—600-piv silicon rectifier (1N2071 or equivalent)
NE—NE-51H neon lamp
Q—2N277
R1—47,000 ohms
R2, R5, R6—5.6 megohms
R3—560,000 ohms
R4—1.8 megohms
R7—120,000 ohms, 2 watts
R8—10 megohms
All resistors ½ watt, 10% except as marked
S1—spst toggle switch
S2—spst N.O. pushbutton
T1—special toroid transformer (see text) available from DAO Corp., PO Box 659, Terre Haute, Ind. for $12.50 postpaid (Ind. residents add 2% tax). Core only, $1.50.
T2—trigger transformer (Amglo ST-25)*
V1—929 (RCA, or General Electric GL-929)
V2—6483 (Sylvania)
V3—flash tube (Amglo HD-2-0)*
Batt—4 size-D 1.5-v flashlight cells
See text and photos for suggestions about case, reflector and incidental parts
*Amglo components available by mail from Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill. The ST-25 costs $2; the HD-2-0, $9.



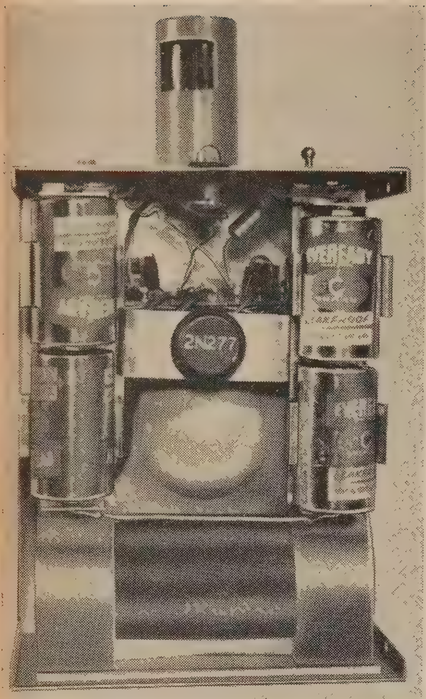
Circuit of complete electronic slave unit. Power supply design can be adapted for many uses.

the voltage on C2 reaches the Zener voltage of D3 at which time D3 cuts off the oscillator. It goes back into oscillation only at intervals to bring the voltage back up to operating level. Thus, not only is conversion efficiency outstanding, but the monitoring action results in low standby current consumption and regulated output voltage.

In operation, the core of toroid transformer T1 is "charged" by the conducting transistor. Then, during the flyback period, while the transistor is nonconducting, the core discharges its energy through D4 into C4, the energy-storage capacitor. Note that rectifier D4 is oriented to block during core charging and to conduct during the flyback period. This gives much greater output. Capacitor C4 is brought up to full voltage by an accumulation of these pulses. During each flyback interval, C2 is charged through the three adjacent diodes to a much lower voltage approximately proportional to that reached by C4. After a number of oscillations the voltage on C2 exceeds the Zener voltage of D3 and biases the transistor base sufficiently more positive than its emitter to stop the oscillations. When the voltage on C2 has dropped, oscillations resume for several cycles to bring the voltage on C2 (and C4) back to the cutoff level. When the unit is flashed and C4 is discharged, the resumption of



View from behind flash. Connections to parts not on perforated board are made to little terminal studs in row along edge of board.



Symmetrically mounted batteries balance the weight of the slave flash unit.

oscillations rapidly brings up the voltage in C4. The voltage in C2 doesn't increase to cutoff until the C4 voltage has reached the operating level. The monitoring action on standby assures the longest possible battery life and the regulated output voltage makes absolutely uniform exposures possible.

All the components in the power converter are readily available except the transformer. It consists of a small doughnut-shaped core of a special high-Q molybdenum permalloy identified as A-930157-2 by the manufacturer, Arnold Engineering Co. of Marengo, Ill. On this core are wound 25 turns of No. 30, 35 turns of No. 18 and 860 turns of No. 35 wire. The big output winding represents a lot of hard work, but these cores can be wound by hand at a considerable saving of hard cash. This special transformer is available at $12.50 postpaid from DAO, P.O. Box 659, Terre Haute, Ind. The bare core is also available from DAO for $1.50 for those who wish to do their own winding.

The firing circuit

The heart of the firing circuit, and the reason for its dependability, is a subminiature cold-cathode thyratron or trigger tube. Many of the older trigger tubes were erratic in operation. The 6483 achieves near-perfect response because of a keep-alive grid which draws only 50 μa but reduces ionization time to less than 5 μsec. When S2 is closed or a bright pulse of light strikes the phototube, the trigger grid of V2 receives a positive pulse approximately equal to the voltage drop across R2, and V2 fires. Then C6, charged to nearly the supply voltage, discharges through the primary of trigger transformer T2. This generates an extremely high secondary voltage which is fed to the flash tube, V3. While the entire high-voltage supply is always across the anode and cathode of the flash tube, this isn't enough to start ionization. The several thousand volts from T2 starts the ionization and the tremendous breakdown energy that produces the light is drawn from storage capacitor C4.

With the components shown in the parts list and a Zener diode of exactly 9 volts, C4 charges to 420 volts and the on–off monitor action allows less than a 5-volt swing. Fresh batteries provide a recycling time between flashes of about 6 seconds. (A much longer time is required the first time, since there is a high leakage loss while the electrolyte in C4 is being reformed.) As the batteries age, recycling time becomes longer, but the same operating voltage is maintained even when they have dropped to half their rated voltage. The peak discharge from the batteries is between 2 and 3 amperes. The operating voltage can be raised or lowered by selecting a Zener diode with a higher or lower Zener voltage. The ready light comes on at 380 volts. If R4 is increased in value, the ready light will ignite at a lower voltage and vice versa.

Modifications

Many modifications are possible. The size and shape of the slave and the arrangement of parts can be varied without impairing operation in any way. The power converter can replace a vibrator in a flash unit already on hand. It's so small it should easily fit in the space occupied by any vibrator supply. The firing circuit may also be incorporated in an existing outfit. It's excellent not only for slave operation but, as a synchronized flash on the camera, its high impedance greatly reduces current through the delicate sync contacts in an expensive shutter and completely eliminates the surprise of an occasional shock from the sync cord.

It's frequently possible to purchase an old electronic flash unit for only a few bucks from a dealer who has taken it in trade. If the flash tube, reflector and energy storage capacitor are in good shape, this can be a real bargain. You may find many of the other components in your junkbox. The trigger tube and trigger transformer are expensive. Winding the small toroid core is not the easiest job but by combining all these economies some very substantial savings are possible.

Precautions to observe are few. Remember that all diodes and transistors can be damaged by excess heat from soldering. Leads carrying high voltage should be well insulated and all components should be solidly mounted to withstand hard usage. Most important of all, respect the lethal properties of a 525-μf capacitor charged to 400-plus volts. While completing the slave or when working on it later, it's an excellent idea to discharge C4 through a power resistor of a couple of hundred ohms to be sure it's really safe. END

WINDING THE TOROID

The toroid core used for the power transformer is doughnut-shaped, 1 inch across and with a hole 0.58 inch in diameter.

The 860-turn output winding of No. 35 Formvar wire is applied first and this is the only difficult part of the job. Approximately 107 feet of the wire must first be wound on a bobbin which is small enough, when wound with the wire, to be slipped through the hole in the toroid 860 times. To keep down the diameter of the filled bobbin, it should be made several inches long. A round, wooden sucker stick makes a suitable bobbin. The ends may be shaped to blunt points and the body of the stick reduced somewhat in diameter without weakening it too much. This allows the wire to be wound on without increasing the diameter too much and reduces the possibility of the wire slipping off the ends and becoming tangled.

You are now ready to apply the 860 turns to the toroid. Apply turn after turn by threading the bobbin through the core. Build up the turns as you proceed; you must have the full number of turns wound by the time you work your way around the toroid and return to the starting point.

This matter of uniform distribution is quite tricky. It may be necessary to remove some of the turns and start over if you see it isn't turning out right. Divide the toroid into quarters or eighths with little spots of fingernail polish to be sure you're getting the correct number of turns in each section as you go. The job will be easier.

When you're finished with this most difficult winding, color-code the leads, being sure to identify start and finish of the winding, and apply a *thin* layer of plastic tape. Be careful not to scratch the insulation and short some turns. Formvar insulation is specified because it's very tough.

The regulator or feedback winding is applied next, and you no longer need bother with the bobbin. Only 4½ feet of No. 30 Formvar wire will be required for this 25-turn winding if the first one was applied neatly. Be sure this winding goes on in the same direction, distribute it evenly around the core and end at the starting point. Color-code these leads, apply a *thin* layer of plastic tape. The heavy power winding goes on last. About 8 feet of No. 18 wire will do for this 35-turn winding. Follow exactly the same system. Be very sure the windings are all applied in the same direction. Space them as smoothly as possible around the core ending at the starting point. Color-code them carefully or you'll waste hours trying to figure them out later. Keep the tape insulation between layers as thin as possible and don't scratch off the Formvar insulation.

Cy and Lucky hunt sound bars

The stacked-B supply is behind this one

By WAYNE LEMONS

"WHY ISN'T MRS. JAMES' SET READY?" demanded Cy. "She just called me at home and told me you told her that it probably wouldn't be fixed before the end of the week. Just how serious can one set be?"

"Sounds to me as if she got you out of bed," responded Lucky. "Anyway, it's the first time you've been to the shop before nine since I've been working here."

"We're not talking about me. We're talking about Mrs. James' TV set. How come it isn't fixed? Just what's the matter with it? Some part we don't have?" Cy asked in rapid-fire fashion.

"One question at a time," begged Lucky. "You see, it's like this: her Super V Crosley has sound bars and I read somewhere that sound bars are caused by misalignment. So, I was waiting for you to fire up the old sweep generator and do the job. You know I don't know much about the sweep gen."

"I'm not too sure you know much about anything! You think old Mrs. James has been adjusting the slugs in the if's or tuner?"

"Well, I don't suppose so, but can't a set get out of alignment on its own?"

"I suppose it is possible." Cy was cooling down a little. (And he knew from past experience that if he said absolutely that alignment *wasn't* the trouble, that sure enough it *would* be.) "Let's take a look at her set and see what we can find out. She told me positively that she couldn't possibly miss today's episode of 'Edge of Night'."

"Can't you take her a loaner?" asked Lucky.

"Sure, we could, but it *might* not be necessary."

They turned the set on, hooked it to an antenna and waited for it to warm up. They waited almost 5 minutes and there was still no picture or sound. Then, slowly the sound appeared and the raster, dim and narrow at first, filled the screen.

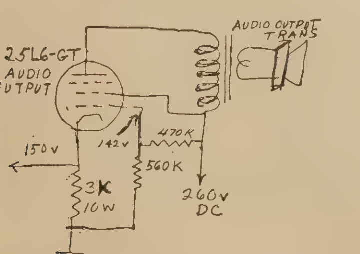


Fig. 1—Cy's schematic showing Lucky how audio output tube acts as voltage divider.

"Most of the Super V's were slow warming up, but that was ridiculous!" exclaimed Cy. "Don't forget to check that Globar heater resistor before we return this set."

"What she's griping about is those sound bars in the picture. See, every time the guy speaks, it looks like the picture has Venetian blinds."

Cy turned the volume down. The sound bars disappeared. "Well, we know one thing for sure," he said, "it isn't alignment that this set needs."

"You mean because you turned down the volume and the lines went away that eliminates the rf and if stages?"

"Well, now I didn't exactly say that, did I?"

"You mean it could still be in the rf or if stages?" asked Lucky.

"Could be," affirmed Cy.

"But how . . .?"

"See this speaker . . .?" began Cy.

"I get it," Lucky was excited. "When you turn up the volume, the sound waves from the speaker could cause a tube or something to be microphonic and that something could be in the if or rf . . ."

"Or oscillator," Cy finished. "Now that the little wheels have started turning, how would you determine if that is the trouble?"

"Well, we could beat on the cabinet," Lucky said as he slammed the side of the set with his open palm.

"Outside of being rather crude and kind of rough on cabinets, your method might be halfway effective. But it wasn't quite what I had in mind."

"What's your solution?"

"Simple. Just disconnect the speaker!"

"But I've read you shouldn't operate any amplifier without a load."

"And it's true," said Cy, "but this set uses a 25L6 in the output and a fairly low-impedance output transformer, so it isn't likely to damage anything if we run the set without a speaker load for a short time. If you're squeamish though, let's do it right. Gimme a 10-ohm 1-watt resistor out of the box. That should match close enough for a test."

They disconnected the speaker and tied the resistor in its place. Cy turned up the volume control—the sound bars were still in the picture!

"Now we know the trouble isn't alignment and it isn't any loose or microphonic parts, right?" asked Lucky.

"Right. The trouble is probably poor regulation of some part of the power supply and that some part is likely the audio output stage."

"You mean the audio output stage is a part of the power supply?"

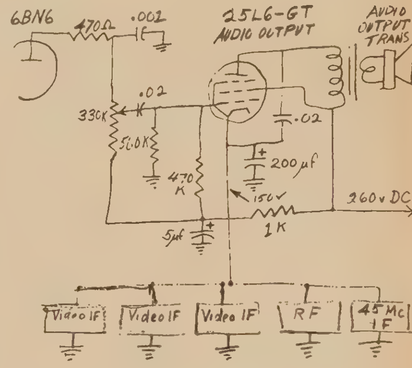


Fig. 2—Lurking in this simplified schematic is the component causing sound bars—and it wasn't the electrolytics.

"Look at the circuit," said Cy. "This has been a favorite circuit with TV designers for quite a while now. Especially in series-heater sets. Note how the 250 or 260 volts from the rectifier doubler is applied to the plate and screen of the 25L6. And note the control grid is also positive. In this case, the positive voltage to the grid is set at slightly more than half of the 260 volts by using a 470,000-ohm bleeder and 560,000 ohms to ground and connecting the grid at the junction."

"But doesn't the positive grid make the 25L6 draw too much current?" asked Lucky.

"Well, it would," said Cy, "except that the cathode is not tied direct to ground."

"Yes, I see," said Lucky, "It's tied to the 150-volt source."

"Correction, it *is* the 150-volt source!"

"You mean the 25L6 is a rectifier?"

"Not exactly, but it does act as a bleeder resistor from the 260-volt source."

"How does it do that?"

"Look at this drawing." Cy made a hasty schematic on a scratch pad (Fig. 1). "Let's suppose that the cathode of the 25L6 has a resistor, say 3,000 ohms at 10 watts, to ground. Now, if we apply a positive voltage to the grid, what happens to the voltage at the 25L6 cathode?"

"It will go up pretty high!"

"Right. And if we replaced the 3,000-ohm resistor with other circuits drawing an equivalent amount of current, we wouldn't have to have the resistor; and the voltage we develop could act as the B-plus supply for these circuits."

"I think I get the glimmer," said Lucky. "The 25L6 sorta acts like an electronically variable power resistor. But what about the audio? Doesn't that

appear on the 150-volt line?"

"Now we're back to the problem at hand. The audio certainly would affect the 150-volt line, if it weren't bypassed with a pretty good size electrolytic."

"Then that could be our trouble, couldn't it?"

"Well, yes, it could," agreed Cy, "and there is a pretty easy way to find out."

"How?"

"With a test adapter socket under the 25L6," replied Cy. "We know that pin 8 is the cathode, so we can look at what is on the 150-volt line with a scope. If we see any audio voltage to speak of when the volume is turned up, we'll know that the 200-μf filter from the 150-volt line to ground just isn't doing the job (Fig. 2)."

"Wouldn't it be simpler just to bypass pin 8 with another filter?"

"Yes, it would probably, but you always have the danger that you might heal the defective capacitor and then you wouldn't be positive that the capacitor was at fault."

"What difference would that make?" asked Lucky. "Even if we healed it, we would still know it was bad, wouldn't we?"

"That's true," said Cy, "but the sudden surge might 'heal' something else that was causing the trouble—then we wouldn't know, would we?"

They looked at the scope and turned up the volume. "The electrolytic is bad," concluded Lucky.

"Sorry to disappoint you but I don't think so," said Cy.

"What do you mean? Look at the trace bounce."

"That's exactly what I mean," returned Cy. "The trace is bouncing. If the filter were open, you wouldn't see that nice clean trace. You'd see a trace that was pretty stable but the straight line of the trace would be blotted out by the audio. In fact, it would be very similar to what you would see at the grid of the audio tube."

"What does this bouncing and bounding trace mean then?"

"It means the dc voltage is changing pretty drastically, I'd say. But to let you make sure, get an electrolytic and shunt it from pin 8 to ground."

Lucky did as he was told. The bars in the picture continued. "I guess you're right," he said.

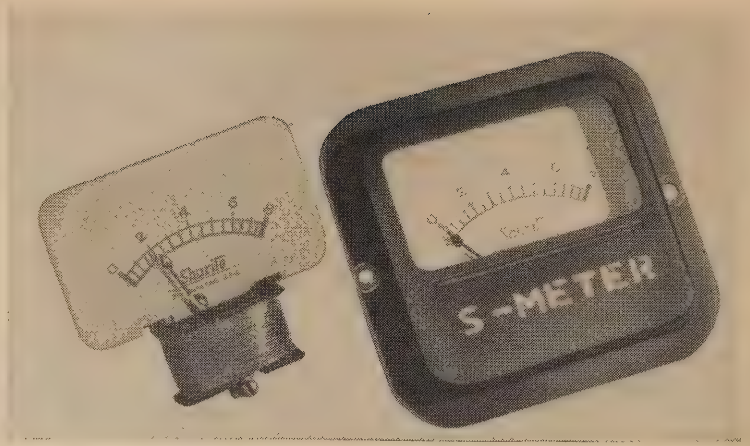
"Here's a chance to use the old noggin," said Cy. "Tell me what you think might be wrong."

"Well, it couldn't be a bad tube, we changed it. It seems like it would have to be something causing the grid voltage to change as people talk."

"And what do you suppose that could be?" asked Cy.

A light shone in Lucky's eye. "The coupling capacitor—it could be leaky. That would change the dc voltage on the grid and therefore vary my electronically controlled power resistor, namely the 25L6."

"Looks like Mrs. James is going to see 'Edge of Night' on her own set after all. Pull the chassis and install the capacitor. I'm going for coffee." END



Meters from junkbox

OLD BATTERY CHARGERS AND ELIMINATORS have usually been scorned as useless for salvage parts. The meters, usually an ammeter and sometimes a voltmeter, are hesitatingly stashed away, waiting that day when their rather crude ranges can be of some practical value. Since most such meters employed are of the iron-vane type, their movements are simple and reliable. Their sensitivity does, however, leave something to be desired.

A meter of this kind is practical for many applications around the ham shack requiring a relative indication. One such example is as an S-meter on a short-wave receiver. The problem was, in our example, how to employ the brute with an 8-ampere full-scale sensitivity to indicate receiver tuning. Opening the meter revealed a coil and movement arrangement such as illustrated in Fig. 1, which is typical of the Shurite meter. The coil consisted of 4½ turns of about No. 14 copper wire. The coil was removed and, as an experiment, 1,000 turns of No. 40 enameled wire was scramble-wound on the form. This resulted in a meter with full-scale sensitivity of 3.5 ma! If an even range is desired, we can remove turns until 5 ma or any other full-scale sensitivity (within the current-carrying capabilities of the wire) is obtained. The photo shows the rewound movement and the reassembled meter. We kept the 0–8 scale and carefully erased DC AMPERES from the scale.

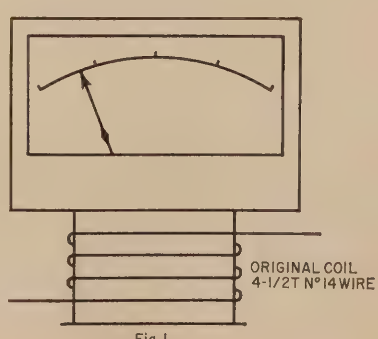


Fig. 1

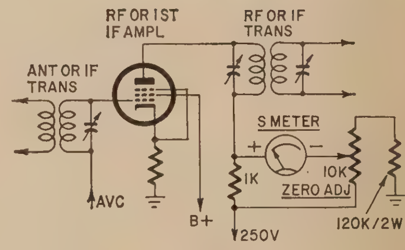


Fig. 2-a

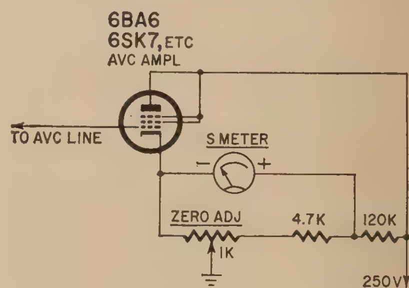


Fig. 2-b

Fig. 2-a shows the meter connected in the conventional bridge circuit in the rf or first if stage of the receiver. Fig. 2-b shows how a pentode such as a 6BA6 or 6SK7 can be employed for avc measurement. This circuit has much greater sensitivity than that which can be obtained from 2-a.

Other meter current sensitivities can be obtained by suitable selection of wire size. The most satisfactory method for nearly "failproof" results seems to be to select a wire size capable of carrying the current desired, then winding the core "full". After checking the sensitivity of this new winding, if it is greater than necessary, a few turns of wire at a time may be removed until the desired full-scale indication is obtained. This type of meter is hypersensitive to steel—its own case as well as the panel into which it may be mounted. All tests should therefore be made with the case intact and the meter in its panel position.—*Harold J. Weber*

ALL-PURPOSE MIXER

Universal triode heterodyner has low noise and a minimum of parts

By RONALD L. IVES

ONE OF THE MOST COMMON TASKS IN electronics is converting one frequency to another. This is generally done by heterodyning, and the usual procedure is to cobble up some sort of an oscillator–mixer for each job. The favorite is apt to be a pentagrid converter, such as a 6BE6, self-excited. Power for the frequency converter is usually robbed from an adjacent circuit.

This expedient works rather well but is inherently noisy and suffers, not only from uncertainties of oscillator calibration, but also from "pulling" at the higher frequencies, unless an unusually sophisticated circuit is employed.

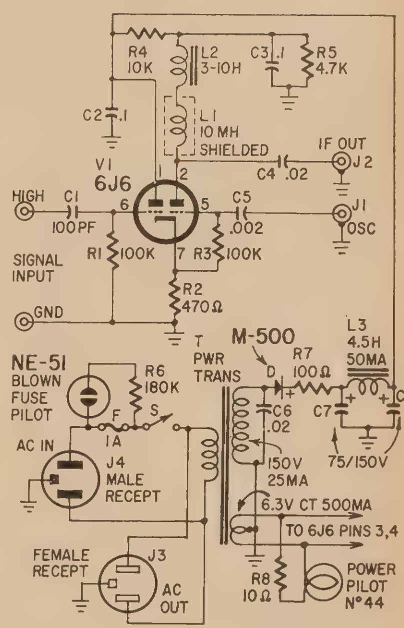
Using the shop signal generator as the oscillator greatly minimizes the calibration problem. Partition noise and pulling are reduced by a very large factor by employing a cathode-coupled mixer, a little known and very satisfactory circuit[1]. The power supply problem is easily met by building in a simple power supply as an integral part of the mixer.

The working circuit of a cathode-coupled mixer, designed for operation at almost any signal and local oscillator frequency from the audio range to somewhere above 150 mc, is shown in the diagram with power supply.

This circuit is simple, straightforward and free of most of the gremlins that make conventional circuits troublesome at times. With signal input, but no oscillator input, the left-hand triode functions as a cathode follower, giving power, but not voltage, amplification to the signal. The right-hand triode, under these conditions, functions as a cathode-driven amplifier, so that the amplified signal, and nothing else, appears at the output. Using a cathode follower here provides the power desirable for a cathode-driven amplifier, and makes coupling from output to input, through the amplifier, virtually impossible.

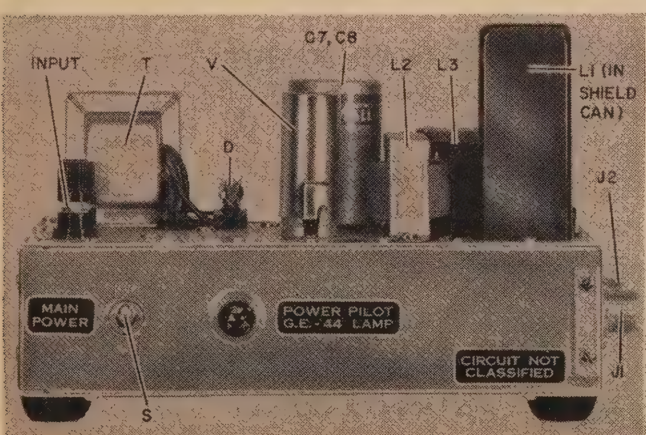
With oscillator input, but no signal input, the second (right-hand) triode functions as a conventional grid-driven amplifier. Only the oscillator frequency appears in the output circuit.

With both signal and oscillator inputs, the right-hand triode operates as a cathode-driven amplifier with respect to signal frequency, and as a grid-driven amplifier with respect to oscillator frequency. Output consists of signal frequency, oscillator frequency, their sum

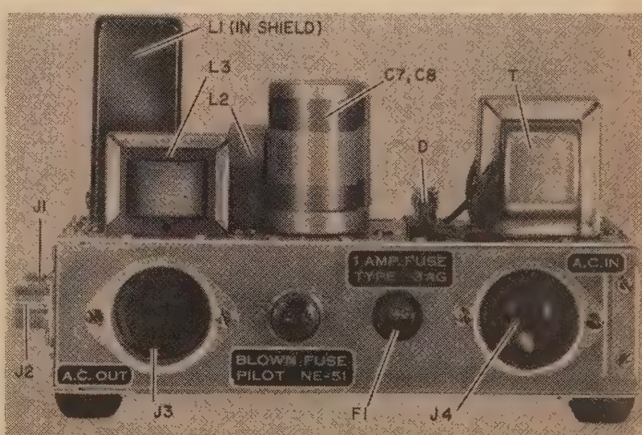


Circuit of the mixer. Works from audio to vhf.

C1—100 pf tubular ceramic
C2, C3—0.1 µf, 600 v, plate ceramic
C4, C6—.02 µf, disc ceramic
C5—.002 µf, disc ceramic
C7, C8—75–75 µf, 150 v, dual electrolytic (Mallory FP 214.5 in Cinch 2-C-7 socket)
D—silicon rectifier, 400 piv, 500 ma (Sarkes Tarzian M-500 or equivalent)
F—fuse, 1 amp, type 3AG, in Litfelfuse 342001 holder
J1, J2—SO-239 coax connector or equivalent
J3—2-wire ac receptacle, chassis-mounting, with ground post (Amphenol 160-4)
J4—2-wire ac plug, chassis-mounting, with ground post (Amphenol 160-S)
L1—rf choke, 10 mh
L2—small filter choke, 3–10 h
L3—filter choke, 4.5 h, 50 ma (Stancor C-1706 or equivalent)
R1, R3—100,000 ohms, 1 watt
R2—470 ohms
R4—10,000 ohms
R5—4,700 ohms
R6—180,000 ohms
R7—100 ohms
R8—10 ohms
All resistors 2 watts, 10% except as noted.
S—spst toggle switch
T—power transformer, 150 v, 25 ma; 6.3 v, 0.5 a, ct (Merit P-3046 or equivalent)
V—6J6
Pilot lamps—No. 44 and NE-51
Chassis, input terminals, socket, miscellaneous hardware



Front view shows only "control": an on–off switch. Label at lower right concerns security—not the kind of circuit!



Peek behind discloses convenience features: removable ac input, auxiliary ac outlet, blown-fuse pilot. Note ac connectors with ground posts.

and their difference. If the signal and oscillator inputs are "clean," containing no harmonics, the mixer output will also be "clean" and lacking in the troublesome harmonic sum-and-difference frequencies that make so much trouble with other mixers.

Although the developer of this circuit[2] recommends, with good logic, that the oscillator output be a low-impedance circuit, such as a cathode follower, experience shows that almost any oscillator output from about 20,000 ohms down works well here.

Construction

This universal triode mixer is easy to construct. All parts, including a well filtered power supply, can be mounted on a 4 by 8 by 2-inch chassis.

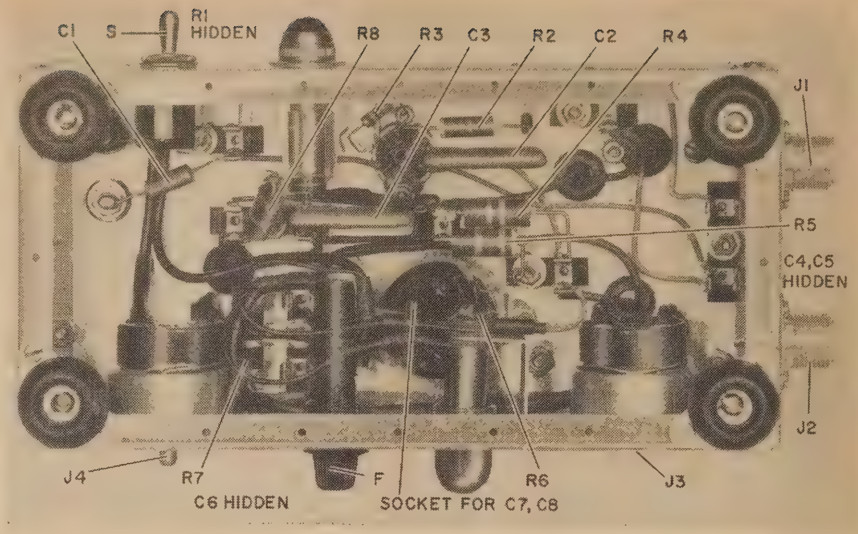
Parts arrangement is not very critical, although some separation of circuits is desirable to minimize interaction. The front view of an excellent mixer of this type is shown in the photographs. Note that the only operating control is an off–on switch. The shield can at the right end of the chassis covers the plate rf choke (L1), minimizing radiation from it. If this choke is left unshielded, it may not only radiate signals at one of the four frequencies in the circuit, but may also pick up stray radiation from other circuits or devices in the vicinity. The result: "gremlins" in the output.

Oscillator input and i.f. output are kept as far from the signal input as possible, to minimize unwanted intercoupling. Shielded leads are recommended here, and SO-239 coax connectors are provided on the right end of the chassis for these connections. Any other shielded connectors can be used here as long as these circuits are tightly shielded.

Top-of-chassis layout is also rather noncritical. The only precaution necessary is mounting plate choke L2 at right angles to filter choke L3 to keep coupling at a minimum. If *thoroughly* shielded chokes (quite costly) are used here, their orientation is not critical, and they can be mounted closer together.

To isolate circuitry and to simplify wiring as much as possible, power supply components are mounted at the rear of the chassis, while signal components are mounted along the front. This permits convenient and direct connections of the input plug, fuse, blown-fuse pilot and auxiliary ac output on the rear-chassis skirt. The ac output, a three-wire industrial outlet, is controlled by the main power switch, and is provided because of the chronic shortage of ac outlets in almost any electronic shop.

In older installations, where three-wire industrial wiring is not used, the input and output plugs can be the conventional two-wire type (Amphenol 61-M10 and 61F10, or equivalent). The purpose of the small capacitor, C6, across the high-voltage secondary of T



Constructor's-eye view shows wiring details. Wiring needs some care to avoid stray coupling.

is to absorb rectifier hash, which produces interference at multiples of 60 cycles to somewhere beyond 60 kc. R7, in series with the rectifier, is a surge limiter, which very greatly increases the life of silicon rectifier D—particularly if the mixer is turned on and off frequently. R8, in series with the power pilot, dims the lamp slightly and extends its life.

Underchassis construction is simple and standard. Liberal use of tie points gives firm support to smaller components, as well as supplying convenient test points. The rubber feet shown in the photos should be removed for actual use, and a bottom plate firmly attached to improve shielding. Chassis holes should be grommeted to prevent chafing of leads and eventual mysterious short circuits. Lockwashers under all holding nuts are strongly recommended.

For operating and maintenance convenience, labels showing the functions of all controls and indicators, the purposes of all connectors and the normal content of all sockets are always desirable. Those here used are Metal-photo labels.

Operation

Using this mixer is even simpler than building it. With all plug-in components in place (don't forget the fuse), the ac connected and the power turned on, connect the signal input to the input terminals. Plug the signal generator into the ac outlet on the back of the mixer and turn it on. The i.f. system is connected to the I.F. OUT jack.

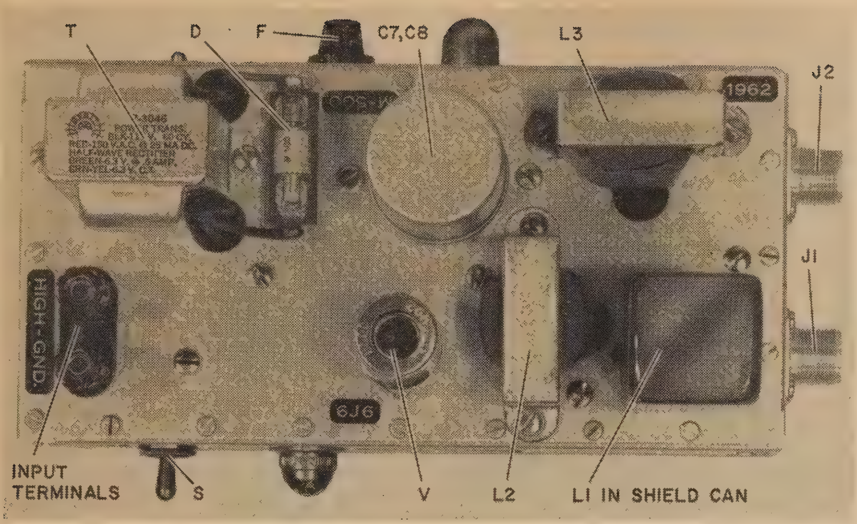
With this arrangement, whenever the i.f. is the sum or difference of the signal frequency and the oscillator frequency, a signal will be produced at the i.f. output. This will be a very clean signal, with a minimum of partition noise, crossmodulation and harmonics. Performance seems equally good at signal inputs of 100 kc and 100 mc. And it is entirely feasible to heterodyne a 500-kc signal down to af if the signal generator is stable enough. Although not specifically designed for it, this mixer can be used successfully as a product detector.

Comparing this cathode-driven triode mixer with the more familiar pentagrid converter gives some interesting results. All other factors being the same, this mixer gives slightly more than three times as much output as the familiar 6BE6. At the same time, partition noise is most greatly reduced, so that signals that were unreadably "down in the noise" with the 6BE6 are clearly readable with the triode mixer. Crossmodulation is considerably reduced, and impulse-noise effects slightly reduced. Oscillator "pulling" is too small to measure.

Performancewise, the triode mixer is superior to anything the writer has tried previously. And this superior performance seems to reach from one end of the spectrum to the other, with no "holes", "bad spots" or other annoyances.

Other applications

In view of the excellent performance of this mixer, it might seem desirable to substitute this mixer for the one in your present receiver and probably cure some of the troubles you now have. In some instances, this would be a mistake, as a few of our better receivers, such as the 75A4 and the GPR-90, already contain superlatively good mixers. This triode-mixer in such receivers would increase the tube complement, make practically no change in the all-important signal-to-noise ratio and increase the input to the i.f. system, already adequately fed.



Bird's-eye view. Layout is roomy, not especially critical. All connectable or removable parts are labeled.

If, however, your receiver is an old model, with a no-signal output that sounds like frying eggs, a change may be in order. Determine first if the frying noise is actually mixer noise. With no rf input to the mixer (pull the rf tube, or short the antenna and ground terminals), note the hiss output. Then pull the mixer tube, and note the hiss output again. If pulling the mixer tube reduces the hiss output by a factor of much more than 2, consider a change of mixer.

Next, check feasibility. Is there room for a separate oscillator–cathode-follower tube (such as a 6U8-A)? Will the power supply carry the extra heater and plate loads without overheating? If the answer to both of these questions is yes, then the change is practicable. Install the triode mixer and the oscillator–cathode-follower, using ordinarily good workmanship, being sure that the mixer is not overloaded.

As the input capacitance of the first triode of this mixer is considerably less than that of a 6BE6 or other converter tube, the receiver will no longer track properly. This difficulty can be corrected by realigning the entire system, a time-consuming chore with a multiband receiver, or by adding a small trimmer (3–15 pf, for example) from input grid to ground. This simple expedient makes realignment simple—one adjustment is adequate for all bands and the original alignment of the receiver is not altered.

With the triode mixer correctly installed, the receiver will sound "dead" with no signal input. It will now, however, receive clearly signals that were never copyable before, and will suffer less from crossmodulation.

This mixer change is most effective with receivers made before about 1950, particularly military units. A similar change gives marked improvement in the performance of single-sideband adapters incorporating 6BE6 and similar tubes, but little improvement in the performance of adapters with all-triode product detectors. The same techniques can be used to "denoise" beat-frequency audio oscillators incorporating other than triode mixers. END

REFERENCES

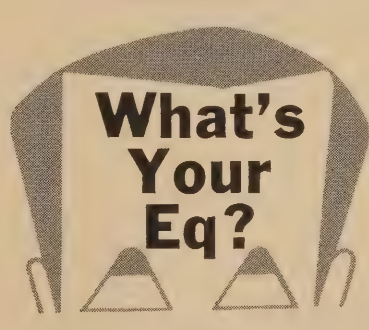
[1]Pullen, K. A., *Conductance Design of Active Circuits.* John F. Rider, New York, 1959; pp 259–263.
[2]*Ibid.*

ECLL800 Tubes from Allied

Readers who had trouble locating ECLL800/6KH8 tubes for the 3-tube 20-watt stereo amplifier on page 28 of the November 1963 issue will be happy to learn that Allied Radio Corp., 100 No. Western Ave., Chicago 80, Ill., is stocking them and accepting orders.

The stock number is 39 A 522, and the price is $4.95 each.

Answers to



This month's puzzles are on page 39

Untermination

Each network has a characteristic impedance of 600 ohms. This can be determined by connecting a 600-ohm load resistor across the output terminals of each and measuring the effective resistance between the input terminals of each network. Both networks will have an input resistance of 600 ohms. Since this is the same value as the load resistance, the characteristic impedance of each network is said to be 600 ohms.

In the tee network, the 600-ohm load resistor is in series with the 200 ohm resistor on the right-hand side of the network, making the equivalent of 800 ohms. This resistance is in combination with the 800-ohm shunt resistor, making a series-shunt combination that equals 400 ohms. By adding the left-hand resistance of 200 ohms to 400 ohms, the resistance between the input terminals is found to be 600 ohms. Since this is the same value as the load resistor, the characteristic impedance of the tee network is 600 ohms.

In the pi network, a 600-ohm load resistor is in parallel with the right-hand 1,800-ohm shunt resistor. This combination equals 450 ohms and is in series with the 450-ohm network resistor, making a total of 900 ohms. The left-hand shunt resistance of 1,800 ohms is now in parallel with 900 ohms, which makes the input resistance across the input terminals 600 ohms. Since the load resistance of 600 ohms equals the input resistance, the characteristic impedance of the pi network is 600 ohms.

Note:

By using the Wye-Delta or Delta-Wye transformation, it can also be shown that the two networks are equivalent. The tee and pi networks are examples of Wye and Delta networks respectively.—*Editor*

Voltage Divider

This puzzle is not as hard as it seems at first glance. Since the four resistors are connected in series, the same current must flow through each. We see that R4 has the same resistance as R2. Therefore the drop across R3 plus R4 is the same as the drop across R2 plus R3—30 volts. The total input voltage is 100.

Doodles

If the horizontal input of your scope is not disconnected from the horizontal amplifier when using internal sweep (about 10 or 12 cycles), simply connect the 60-cycle test signal to the vertical input, and also to the horizontal input through a small capacitor for a 90° phase shift.

If the horizontal input is disconnected when using internal sweep, connect the capacitor from the 60-cycle test to the horizontal amplifier internally with a clip lead.

by Jack Darr
Service Editor

Service clinic

This column is for your service problems—TV, radio, audio or general and industrial electronics. We answer all questions individually by mail, free of charge, and the more interesting ones will be printed here.

If you're really stuck, write us. We'll do our best to help you. Don't forget to enclose a stamped, self-addressed envelope. Write: Service Editor, Radio-Electronics, 154 West 14th Street, New York 10011.

WHAT IS A "TECHNICIAN"? HE'S A SKILLED workman who can put things back together again. His job is to "renew" various pieces of apparatus, often highly complex. This demands a lot of knowledge of the basic theory behind this particular gadget. Not in the sense of being able to design it, but he must know more about the *performance* of the thing than the engineer who built it!

In fact, he should be, and is, able to tell the designer many things that *he* doesn't know about what will happen under certain circumstances; demonstrate phenomena that were considered impossible! Many things that textbooks have claimed were impossible have been demonstrated in actual use by the trained technician. This has long been known to ham radio operators, TV service technicians and bumblebees, who went calmly ahead making long-distance communication possible on certain frequencies, picking up TV stations far over the optical horizons, and flying, when the textbooks agreed that it couldn't be done.

It is no part of the technician's job to be able to design apparatus. That is, he is not required to know the highly complex formula needed to be able to *make* a coil. He does have to know what a coil does in a given circuit, so that he can go to a catalogue, select, say a 10-μh coil, and make the circuit work again! He doesn't make capacitors, yet he knows a lot more about how they work in some circuits than the designer! He invariably knows more about some of the weird and "impossible" symptoms that certain defects can cause in all kinds of electronic apparatus.

This comparison of knowledge between design engineers and technicians is not to be considered derogatory to either. Although each must have a common foundation in the basic laws of electronics, the *application* is entirely different. The design engineer's function is to take certain components, and make a circuit that will do certain things. The service technician's task is to make that circuit work as well as it did when it was new. He does this by a combination of knowledge (theory) and knowledge (practical experience). By his knowledge of these essentials, he knows not only what each part is, but *how it works* in actual apparatus, and, more important for his job, how the apparatus reacts when it *fails*. He must be able to take the symptoms displayed, and reasoning from this, diagnose the fault. This requires a very high order of skill!

The skills of the designer and technician are completely complementary. (Though at times the language each uses about the other is far from compl*i*mentary!) Each needs the other, since neither could go it alone. To my way of thinking, the two branches should have equal respect!

Connections to tinsel wire

I'm enclosing a sample of wire. The conductor is wrapped around a thread or something! I've run into this in several things, including the cord on my shaver, earphones and so on. I've had a heck of a time trying to make connections to it. How do you do it?—W. M. K., Gaylord, Mich.

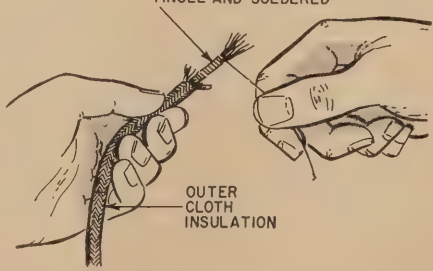


Fig. 1—Impossible to solder tinsel cord?

This is what we used to call "tinsel wire" (when there were ladies around) and, you're right, it's not easy to do anything with. I've found only one practical way to handle the fuzzy stuff.

Very carefully strip off the insulation, breaking as few of the delicate wires as you can. Get a very fine bare or tinned wire, by stripping out a piece of test lead wire or something like that. Start wrapping at the insulation, and lay a wrapping of the bare wire up the strands (Fig. 1). Now solder with a very clean iron and a low-melting-point solder. The bare wire will hold the solder and leave a good contact surface. Clip off the ends of the wrapping wire *after* the solder sets.

Caution: you can't use this wire without providing some kind of strain relief for it. The wire itself has no strength at all, so clamp or tie the whole wire in some way so that there's no strain on the connections.

Delayed fuse blowing

An RCA KCS-81J chassis warms up, compresses the raster a little on the right, then blows a fuse in the high voltage (the 0.25-amp one). I put in a new flyback and yoke, and it still blows fuses! Help!—P. G., Johnstown, Pa.

All cases of fuse blowing have a cause; by checking and *isolating* causes, we get an idea as to where it is. Here's a real crystal-ball diagnosis on this one: check the horizontal linearity coil and its associated capacitors. Try hooking a 250-ma pilot light across the fuseholder. It'll light at the normal current, and flare up if an overload occurs.

Reasoning: since this fuse blowing doesn't show up until the set warms up, I suspect something in the damper circuit, and you've already changed the tubes, yoke, etc. Try adjusting the linearity coil with the lamp in the circuit, you ought to be able to get a "dip" (dimming of the lamp) if the coil–capacitor combination is working as it should.

Too-high collector voltage!

I don't have enough output from a Chevrolet 987888 auto radio. Very weak sound. The schematic calls for 1.5 volts on the collector of the output transistor. With the audio output transformer ungrounded, I read about 10 volts. Ground the transformer, and there is no voltage on the collector.—J. A., Peekskill, N.Y.

This radio has a DS503 transistor in the output stage. The 1.5-volt reading is correct. The 10-volt reading with the output transformer *ungrounded* is a "collector-open" voltage and is *normal.* In very low-impedance circuits like this, speakers and other loads should always be connected when making measure-

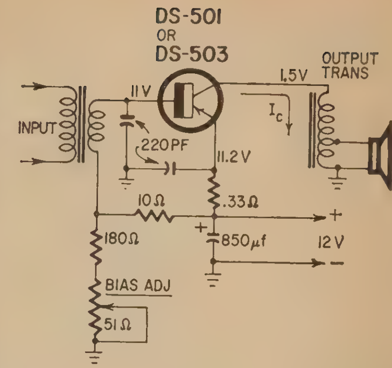


Fig. 2 — Typical single-transistor auto radio power output stage.

ments! Otherwise you upset the impedance so badly that you may damage the transistor.

Your collector voltage here is the *voltage drop* across the very small resistance of the output transformer and speaker! Current must be fairly high to give you any drop at all, since the average resistance in such circuits is only a few ohms. If you have *no* voltage on the collector, it means one of two things: either the transistor is open (not drawing any current at all) or there is a direct short in the collector circuit. With no resistance, you won't have any voltage drop. Check the output transformer very carefully. While these are usually wound with very heavy wire, I have found open joints and similar troubles in some. (Very few, but enough to make it worth while to check.)

Fig. 2 shows the basic circuit of such an output stage.

Half-blacked-out screen

More than half of the screen of my RCA KCS-97 TV is blacked out and distorted. The rest has raster, but no signals on it. Looks like a pulling, tearing foldover from the left side!—S/Sgt. R. S., APO 123, N. Y.

This is a horizontal trouble, and, from the description, caused by *something* getting into the video or even into the horizontal sweeps. I'd check all of the electrolytic capacitors anywhere near these circuits. Also, don't forget to check the *input* filter capacitor! Although it's "a long way from the trouble," it can very definitely cause just such symptoms. Basic cause, lack of *decoupling* between horizontal circuits and video circuits, plus whatever assorted ripple is getting in to complicate things.

17TP4 substitute

Is there a glass replacement for a 17TP4 metal-cone CRT?—L. H. F., Morgantown, W. Va.

Yes, several. The 17TP4 being a rectangular tube makes the job easy, especially fitting the mask and front panel. The 17LP4A and 17HP4B are almost exact duplicates electrically, and

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Chart the course of Heathkit's VTVM throughout the past 15 years, and you'll discover many refinements, many advances. To improve sensitivity, the meter movement was changed from 500 microamps to 200 microamps, and the minimum voltage range was lowered from 3 volts to 1.5 volts. There's now a choice of 7 ranges for AC, DC, and Ohms readings instead of 6. The meter face has been enlarged from 3½″ to 4½″ for easier reading. We did, however, keep the same shatterproof quality of the cover. A voltage doubler replaced the half-wave rectifier, and the range switch was simplified for easier assembly and improved circuitry. With the V-7A came circuit board construction for greater stability and quicker, easier assembly. And our newest, the IM-11, has a single test probe instead of three for all readings. Although the basic compact shape and size has changed very little, the color styling has been modernized for a more attractive, "up-to-date" appearance.

This is just a sampling of the improved design, the higher quality components, and the advanced features that have been incorporated into Heathkit's VTVM over the years. And you enjoy all of these improvements for only 45c more than the original V-1! No wonder Heathkit has sold more VTVM's than anyone else!

Although some of these advances have come from our own laboratories, many of them have evolved from the largest Research & Development department in the world . . . *You!* Yes, you and the hundreds of thousands like you who buy and use our products. Many of you have written us and suggested changes, refinements, and improvements. And we've *listened.* We've *acted!* And we will continue to do so in order to bring you *constantly improving* value.

Check the specifications for the IM-11 (below), and see if you don't agree that for all-around performance in the electronics servicing industry there's not a better buy than Heathkit's IM-11 VTVM!

Kit IM-11, 5 lbs.................$24.95
Assembled IM-11, 5 lbs...........$46.75

SPECIFICATIONS—Meter scales: DC & AC (RMS): 0-1.5, 5, 15, 50, 150, 500, 1500 volts full scale. **AC peak-to-peak:** 0-4, 14, 40, 140, 400, 1400, 4000. **Resistance:** 10 ohm center scale x1, x10, x100, x1000, x 10K, x 100K, x1 meg. Measures .1 ohm to 1000 megohms with internal battery. **Meter:** 4½″ 200 ua movement. **Multipliers:** 1% precision type. **Input resistance DC:** 11 megohms (1 megohm in probe) on all ranges. **Circuit:** Balanced bridge (push-pull) using twin triode. **Accuracy:** DC ± 3%, AC ± 5% of full scale. **Frequency response:** ± 1 db, 25 cps to 1 mc (600 ohm source). **Tubes:** 12AU7, 6AL5. **Battery:** 1.5 volt, size "C" flashlight cell. **Power requirements:** 105-125 volt 50/60 cycle AC 10 watts. **Dimensions:** 7⅜″ H x 4-11/16″ W x 4⅛″ D.

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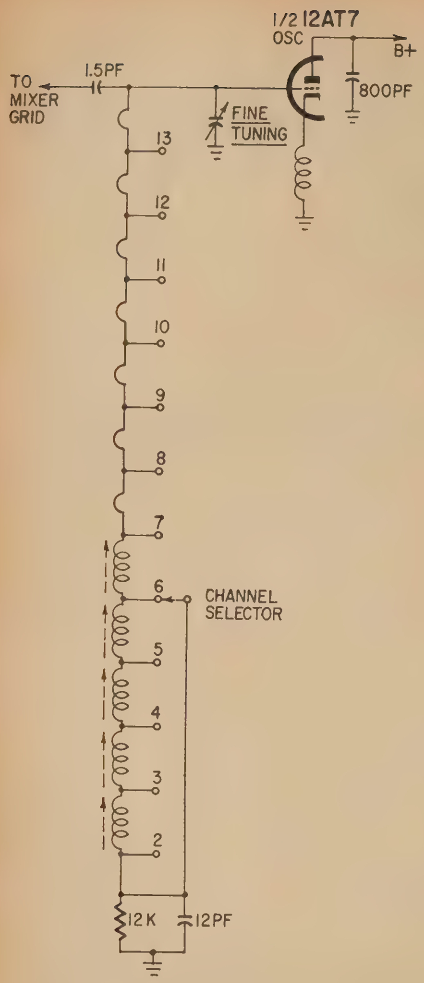


Fig. 3—Change in lead length of grid resistor and capacitor can change frequency.

the dimensions are very close. The 17-KP4 self-focus type could also be used, or a 17VP4. Price and availability would be the main considerations.

Channel 13 gone after tuner repair

I had zigzag lines and diagonal bars and a lot of interference in a G-E 17T2 tuner. I replaced the 12,000-ohm resistor and the 12-pf capacitor in the tuner, from the oscillator coil to ground. Now I get good sharp pictures, but I get channel 11 on 13, channel 8 on 10, and so on! Channel 2 is OK. Haven't realigned the tuner yet.—P. S., Houston, Tex.

Well, you're going to! This ought to be reasonably easy, though. Since the 12,000-ohm resistor and 12-pf capacitor were the only parts replaced and you now get a good picture, this "area" must be where the trouble is. Check very carefully (or try to remember) to see if the *lead length* of the new parts is the same as the original! If so, then look to see if one of the coils for the high channels has been bent or moved. This is a pretty tight place, and you may have accidentally moved something in replacing the R-C network. It doesn't take much excess lead length for parts to have enough inductance to move the oscillator frequency quite a bit (Fig. 3).

You can probably find the exact cause of this by setting up a sweep alignment test, putting the curve on the scope for channel 11 and then jiggling parts to see which one brings it back up to where it should be. Try carefully shorting leads to ground on the grounded end of the R-C combination, as a starter. You can do this on a station signal, but you can see more of what you're doing by using the sweep-response curve as an indicator.

Assorted vertical troubles

A Zenith model C2223, chassis 16C21, has vertical troubles. When it's first turned on, there's a vertical jitter and a whitish area down about two-thirds of the way from the top, about ½ to ¾ inch wide. After the set's been on for an hour or so, the raster fills up and the picture looks normal. I've replaced the tube with no results. The vertical jitter and streaking appear and disappear intermittently.—J. H., Norfolk, Va.

I think this is our old friend, intermittent electrolytic troubles! This is quite a common defect, in vertical circuits, and generally comes from insufficient filtering somewhere in the power supply.

Check around the power supply with a scope, using a low-capacitance probe, for excessive hum or spiking on the B-plus. Vertical spikes from the vertical output stage can cause some very peculiar effects if they are allowed to feed back into other circuits, especially the oscillator. This is the probable cause of the streak in the picture, which is due to compression of the raster at that point. Several scanning lines are being crowded together there, causing the white streak and the distortion of figures, etc., when they show up in that area (Fig. 4).

Bridge the suspected capacitors with a good unit, something like a 50–80 μf,

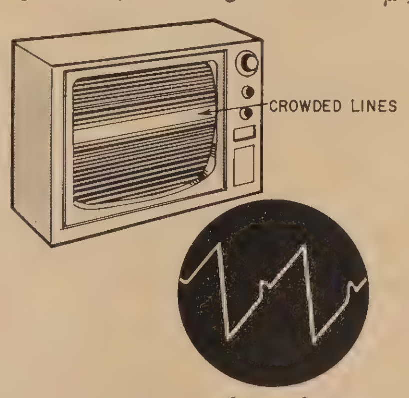


Fig. 4—Spurious signal mixed with vertical scanning wave can distort raster and images.

450 volts, or better still, disconnect them and check for leakage on a good capacitor tester. This type of trouble is often caused by capacitors with a high power factor, which can't be eliminated by just bridging them.

RCA chassis: low horizontal drive

The brightness and width are both off in an RCA 21T7152 TV in my shop. All tubes have been replaced. I've got −4 volts on the 6DQ6 grid, and all other voltages are normal. I suspect the flyback transformer.—A. A., Corpus Christi, Tex.

I'm afraid not! With only −4 volts of horizontal drive on the 6DQ6 horizontal output tube, you aren't going to get much of anything! While I am not sticking my neck out to the extent of saying that the flyback is definitely good, I'd get that drive voltage up to normal *first,* and then see what happens. I wouldn't be surprised if that didn't cure your troubles.

This is probably due to an increased resistor somewhere in the horizontal oscillator plate supply, a slightly leaky coupling capacitor, or anything else that will reduce the efficiency and output of the horizontal oscillator. For a conclusive test on the flyback, try using external drive signals from a good TV set. This will either clear up the trouble or definitely point to a bad flyback.

Crosley 17TOMH: sound, no video

I can't get a signal at the grid of the video amplifier, but I've got sound. No sign of a composite signal ahead of this point. The set is a Crosley 17TOMH. Some of the B-plus voltages are off, and I don't have much high voltage. Damper tube has the same voltage on both plate and cathode. Help!—J. N., Palestine, Ill.

First things first! Remember the old axiom: always fix the power supply *first!* Your symptoms seem to indicate some trouble in the flyback or yoke. The identical voltages on plate and cathode of the damper always indicate boost troubles. This could be due to a bad yoke or to lack of drive for the horizontal output tube. However, since you do have some high voltage, it's probably low drive. Check the yoke and flyback for shorts, and replace the damper tube.

From your remarks, I'd say that you could be using the wrong probe on that scope when you get around to checking signals. *After* the video detector, use a low-capacitance probe; *before* the video detector, use a detector probe for anything in the video i.f.

Incidentally, if you do have sound, this means that there must be some signal getting as far as the video detector! Sound is produced at that point by the beat between sound and video rf signals. So the video is getting there though

maybe not as strongly as it should, due to a weak i.f. amplifier tube, etc., but it is definitely present. Use the right probe, and you'll be able to see it.

No sweep, no boost

There's no sweep, no boost and no voltage on the 6DQ6 plate or the 6AF3 cathode in a Motorola TS-552. Tubes all light. For a minute, I had a thin horizontal line on the screen. Now, the 6AQ5 vertical output tube's plate is red-hot. Tried feeding 60-cycle heater voltage to the grid of the 6AQ5, got nothing. B-plus fuse OK.—P. D., Huntsville, Ala.

Even though that 6AF3 damper tube is lit, it isn't conducting. Replace

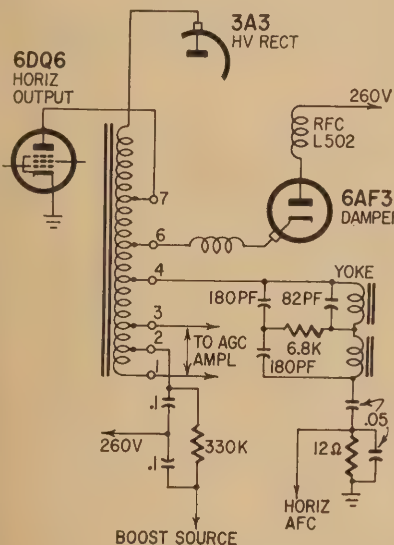
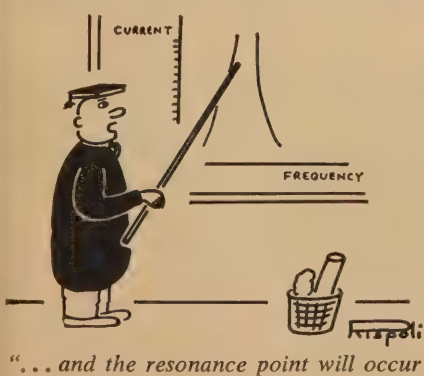


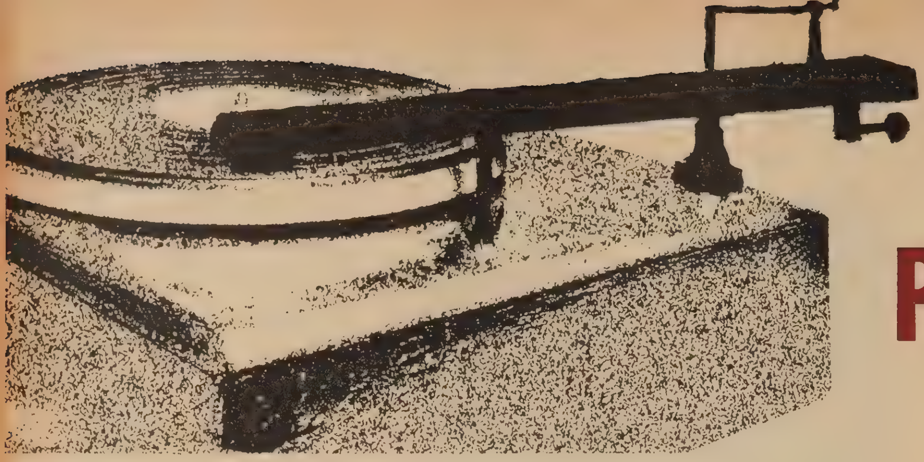
Fig. 5—Defective damper in this set kills boost voltage, horizontal sweep and high voltage.

it. You have no boost voltage because of that. Notice in this circuit that the damper tube *must* be conducting, for voltage to show up on the 6DQ6 plate or the damper cathode! There is no dc path from B-plus to the flyback windings (Fig. 5).

It's remotely possible that this circuit is broken by a defective part, for instance an open rf choke L502, but the most likely cause is an open cathode in the damper tube. END



"... and the resonance point will occur somewhere on the third floor."



HI-FI PICKUP ARM
—theory and practice

By W. F. HUGHES and E. W. GAYLORD *

Commercial pickup arms offer a wide variety to the audiophile. Simple kits to expensive transcription arms are priced from a few dollars to beyond the means of many enthusiasts. Everyone seems to have his own ideas of how an arm should be made and what it should do. This article reviews briefly some criteria which should be considered in the design of a pickup arm, and describes a home-built arm for mono or stereo. In this design we tried to incorporate all the features set forth in the design criteria for optimum performance and yet retain the elements of simplicity, ease of construction and very low cost. The complete construction details presented may be followed exactly or used as a source of inspiration by persons building their own pickup arms. The design as presented will result in an arm that will perform to the complete satisfaction of the hi-fi enthusiast.

The objective of pickup arm design is to provide a mount for a cartridge that permits it to track the record grooves while causing the least amount of distortion or coloration. The conventional system uses an arm which is pivoted at one end on a base and which holds the cartridge in its other end. Ideally, the arm should keep the cartridge perfectly horizontal above the groove while exerting some small downward force and, as the stylus tracks inward, keep the stylus and cartridge tangent to the grooves of the record at the point of contact. Obviously, as the cartridge moves inward and the arm rotates about its pivot point, the tangency of cartridge and groove cannot be maintained. Hence the arm is bent, offsetting the cartridge mount and allowing the cartridge to line up tangent to the grooves at two different radii instead of only at one radius, which would be the case if the arm were not bent or offset. The tracking error or deviation angle from tangency can then be made zero at two different radii, reducing the maximum tracking error. It is also obvious that the longer the arm, the smaller the tracking error. The following quantities can be related by simple geometry and together determine the basic dimensions:

1. Maximum tracking error;

2. The radii where zero error occurs, r_1 and r_2;

3. Arm length (straight-line distance from the pivot point to the stylus), L;

4. Distance from the record center to the pivot point, H;

5. Head angle or offset angle θ;

6. Overhang of stylus past the record center, d.

Referring to Fig. 1, the following relationships can be derived:

$$H = \sqrt{L^2 - r_1 r_2}$$

This gives the mounting distance (H), once the radii (r_1 and r_2), where zero tracking angle occurs and the length of the arm (L) are decided upon.

$$\sin \theta = \frac{r_1 + r_2}{2L}$$

and then the overhang is simply:

$$d = L - H$$

r_1 and r_2 are usually picked in a compromise fashion since 12-, 10- and 7-inch records each have different values for optimum performance. Commercial arms vary and are usually made with $r_1 = 2.5$ to 3.5 inches and $r_2 = 4$ to 6 inches. If only one type of record were to be played, r_1 and r_2 could be determined by mimimizing the time averaged error. In Fig. 2, a plot of L, overhang d and offset angle θ is given for r_1 and r_2 held at 3.25 inches and 4.75 inches, respectively.

* Dept. of Mechanical Engineering, Carnegie Institute of Technology, Pittsburgh, Pa.

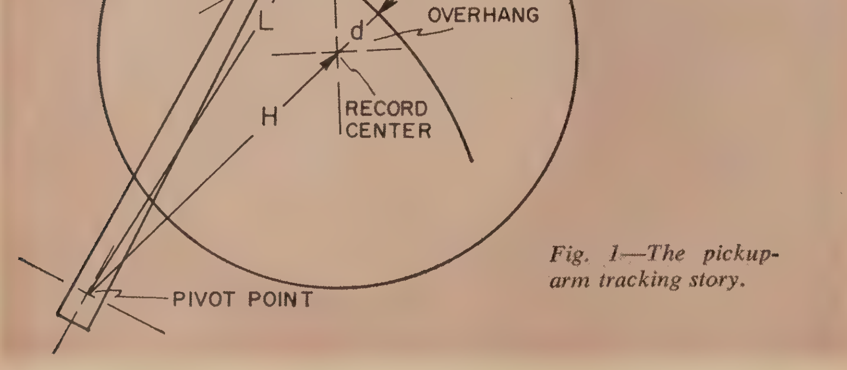


Fig. 1—The pickup-arm tracking story.

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What does it mean? It means that with RCA kits you can get a rofessional V-O-M or VTVM for as little as $29.95*. Or you can et a good oscilloscope (one of the most useful—but normally ne of the most expensive—test instruments) for only $79.50*

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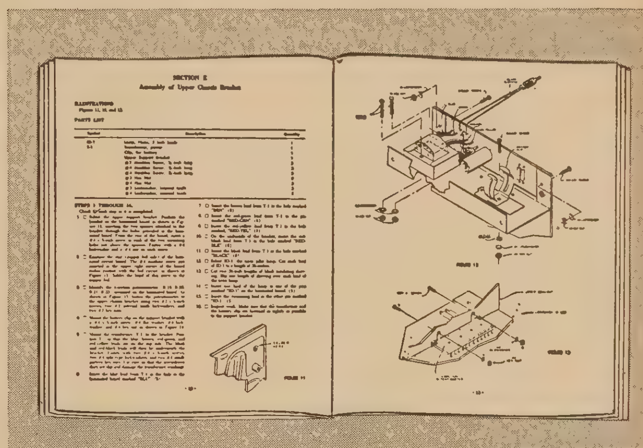
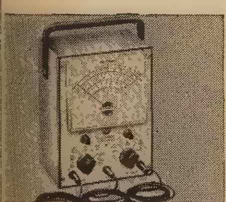
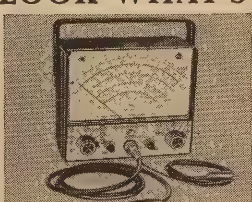


Each sub-assembly is described in a separate section with illustrations applying to that sub-assembly available at a glance. No cross referencing necessary.

LOOK WHAT'S AVAILABLE TO YOU IN KIT FORM:



A VOLTOHMYST®. The most ular VTVM on the market. -77E(K). Kit price: $29.95*



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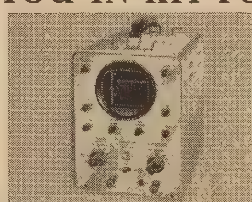

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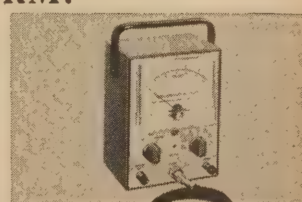

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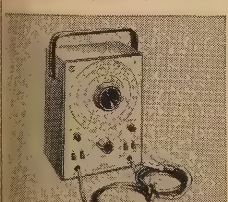

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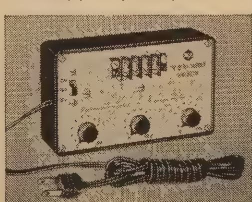

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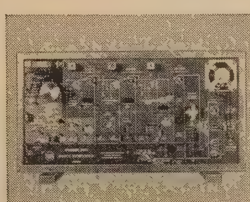

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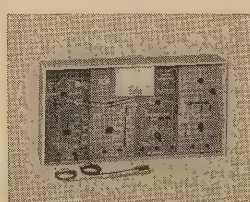

RCA V-O-M DYNAMIC DEMONSTRATOR. A working V-O-M. WE-95A(K). Kit price: $37.95*

See them all—and get full technical specifications for each—at your local Authorized RCA Test Equipment Distributor. Or write for information to: Commercial Engineering, Section E-39-W, RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N. J.

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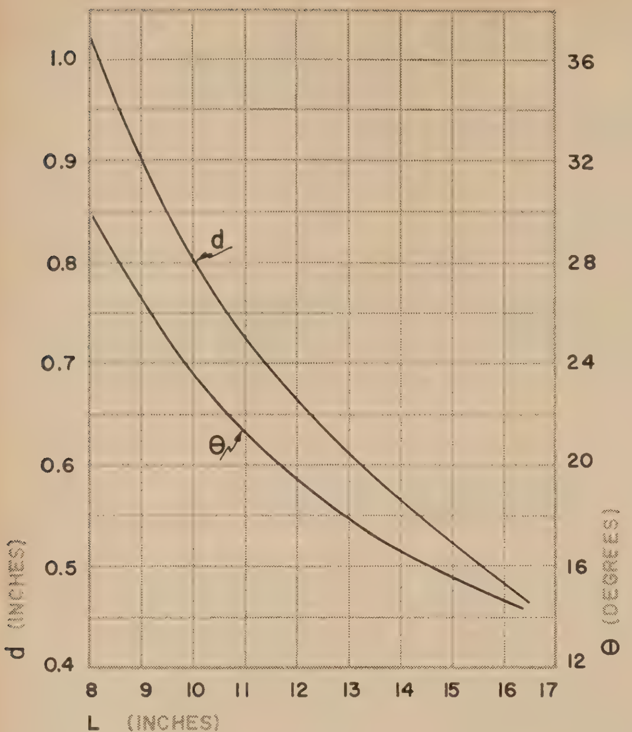


Fig. 2—Relationship between overhang (d), and offset angle (θ) vs length (L).

Let us analyze the actual requirements for good design:

1. L should be made as large as possible without causing excessive vibration or horizontal or lateral inertia.

2. The cartridge should be fastened to the arm direct, not to an articulated head or offset. Articulation can cause sudden changes in the angle of the cartridge with respect to the horizontal when playing a badly warped record and thus cause wow, flutter and possible distortion. The longer the arm, the smaller the angle of horizontal deviation since the radius of rotation is the length of the arm instead of the length of only the head in the case of an articulated cartridge head.

3. Fairly low vertical and lateral inertia is desirable to allow compliant movement of the cartridge up and down because of record warping, and from side to side because of off-center record holes. Few records have holes exactly centered and the arm is constantly moving with every rotation of the record. However, it is extremely important to match the effective inertia of the arm to the compliance of the cartridge. If the arm's effective inertia is too small, bass response suffers and low-frequency resonance may result. If the inertia is too great, the force on the needle may change with arm motion and distortion may result. The design criterion here is formulated by considering the pickup arm as a mass moving against the stylus acting as a spring, and then insuring that the natural frequency of this system is well below the lowest bass response of the hi-fi system. For any system, 10 cyles will insure flat nonresonant bass response. If balsa wood is used for the arm, a simple formula can be given for the correct mass of the arm assembly. The following equation has been derived by considering the effect of the counterweight and balsa-wood arm (as described in the following section):

Let M_t = total weight of the cartridge plus its mounting plate and screws measured in grams.
Let M_e = cartridge weight in grams.
Let M_p = weight of the mounting plate and screws in grams.
Let C = cartridge compliance in cm/dyne.

A fairly accurate formula for estimating the proper weight for the mounting plate is then:

$$M_e + M_p = M_t = \frac{150}{10^6 \times C}$$

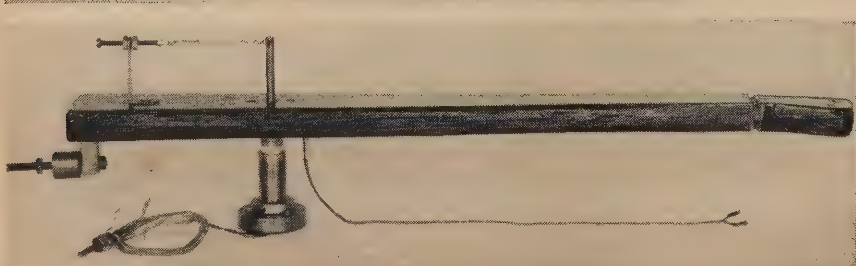
As an example, let us assume that for a particular cartridge $C = 6 \times 10^{-6}$ cm/dyne. Therefore, M_t must be 150/6, or 25 grams. Now suppose the cartridge weight is 10 grams. The $M_p = M_t - M_e = 15$ grams, which is the total weight of the mounting plate and mounting hardware such as screws used to mount the plate to the balsa-wood arm. This mounting plate should be a nonmagnetic material such as aluminum or brass.

If a uniform nonmagnetic arm is used, requiring no mounting plate, a more complicated analysis should be made to determine the arm—cartridge system's resonant frequency.

4. The external damping in the system should be ideally a very low viscous type, such that the static coefficient of friction is actually less than the dynamic value. Frictional damping systems have inherent high static coefficients of friction and are undesirable because of resistance to initial motion and consequent effect on the stylus force.

5. Needle talk is caused by mechanical resonance of the pickup arm and

Home-built pickup arm showing construction details.



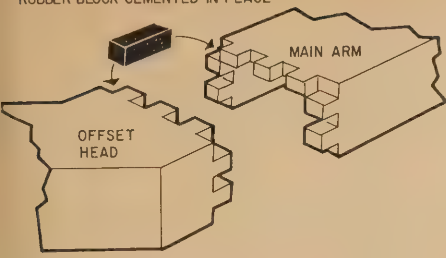


Fig. 3—How the offset is fastened to the main arm.

cartridge at audible frequencies. Whenever the program material has frequencies at or near these resonant frequencies, the entire arm-cartridge system begins to vibrate. Sometimes, in poorly designed arms, the amplitude of the vibration is so great that it can be heard some distance away even with the amplifier switched off. This is the way sound was reproduced in the old-fashioned Victrola.

These mechanical vibrations are fed back to the cartridge and amplifier in a distorted fashion, ruining the transparency of the sound and making it muddy whenever loud passages are played. Needle talk can be eliminated by making the resonant frequencies lower and higher than the audible range of hearing or by damping them out with internal damping.

6. The arm should be statically balanced to minimize the effect of shock and provide a constant tracking force whether or not the turntable is level. Ideally, if the record could be held on the table, the pickup arm should play upside down. The tracking force must then be applied by a spring if the arm is statically balanced.

7. The wire leads should be run from the cartridge through the arm in a manner that minimizes drag or forces on the arm when it is rotated.

Now let's build one

With these ideas in mind, an actual arm was built. Balsa forms the body of the arm. This wood has low mass density, low elastic modulus, and is easily worked. The result is a low natural frequency and very light weight. Pivot bearings are Teflon, to provide a static coefficient of friction lower than the dynamic value. A movable counterweight and an adjustable spring provide the desired tension for static balance. Internal damping is provided by rubber blocks which connect the offset head to the main part of the arm (Fig. 3). The rubber is stressed in shear, which results in ideal damping characteristics.

The arm offset and main arm are notched around the periphery of their butt ends to receive the rubber-block spacers, which are held in place by Goodyear Pliabond rubber cement. The assembly must be held together for about 48 hours while the cement sets. If the parts are not held firmly together while the cement hardens or if the arm is used before the cement is fully dry, the offset will tend to sag and pull the cartridge out of the horizontal plane. The cartridge must be horizontal; if there is any sagging, use shims under its rear. The blocks are a medium-hard natural rubber, but something like the tread from an automobile tire will work well.

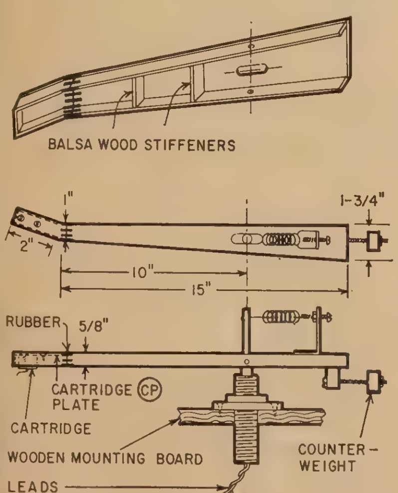


Fig. 4—Pickup-arm detail.

Construction details are shown in Figs. 4, 5 and 6. The arm is fabricated into a U-section of 1/4-inch balsa sheets, and the bearing assembly is machined from brass and Teflon. Since the exact positioning of the stylus depends on the cartridge used, distance L must be measured exactly after the arm is completed and the cartridge inserted. Then distance H and the overhang can be calculated from the first three equations and the hole drilled in the mounting board to accommodate the arm bearing-mechanism mount.

The balsa arm is made, using Duco or similar airplane cement, in one piece including the offset head and then cut at the offset bend and the rubber blocks inserted. As shown in Fig. 4, the blocks are about 1/8 x 1/8 x 5/16 inch, spaced about 1/8 inch apart in grooves around the outer edge of the wood. Goodyear Pliobond cement fastens them in place. This cement is slow-drying and should be allowed to dry about 48 hours. The arm can then be sanded and lacquered or otherwise finished.

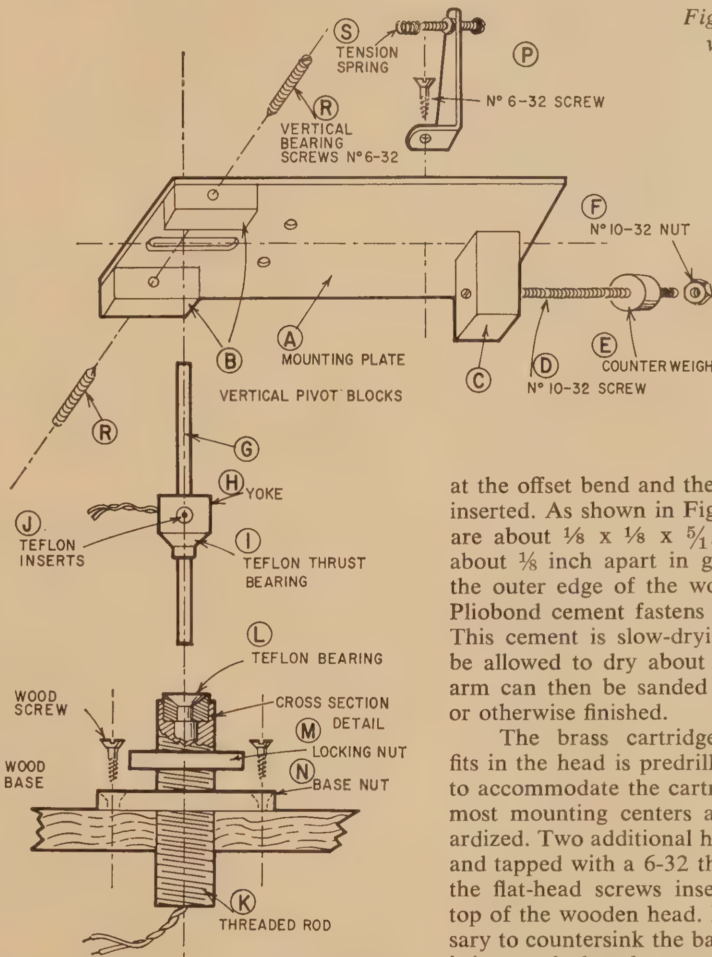


Fig. 5—Exploded view of bearing mechanism.

The brass cartridge plate which fits in the head is predrilled and tapped to accommodate the cartridge, although most mounting centers are now standardized. Two additional holes are drilled and tapped with a 6-32 thread to accept the flat-head screws inserted from the top of the wooden head. It is not necessary to countersink the balsa wood since it is so soft that the screws pull up into the wood without any difficulty. The rear bearing assembly is fastened to the arm with 6-32 screws in the same manner.

All hardware was machined from pieces of brass stock and 1/16-inch brass plate gleaned from a machine shop scrap bin. These parts and their method of assembly into the tone arm are shown in exploded form in Fig. 5 and in detail in Fig. 6. Note that in the fabrication of the assembly, brazing predrilled and threaded brass blocks to the counterweight plate eliminates any difficult machining.

To do a good job on the brass

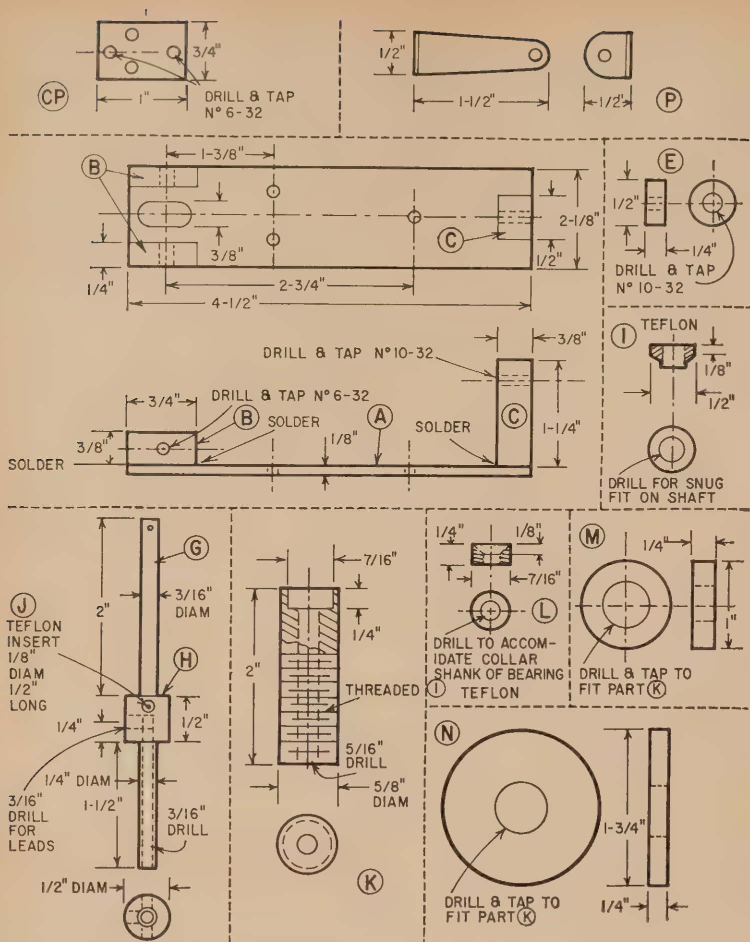


Fig. 6—Detailed view of all bearing parts.

parts, you will probably have to have access to a metal lathe. However, you could probably make the parts from standard brass stock by brazing.

The horizontal bearing features a Teflon bushing which fits into a Teflon sleeve. It is desirable, because of the frictional properties of Teflon, to have Teflon rubbing on Teflon rather than Teflon on metal in bearings this size. Hence the Teflon bushing has a slight collar which extends downward over the journal a little so that radial as well as thrust loads are carried by Teflon on Teflon.

The Teflon bearings are made of stock rod Teflon, obtainable from most industrial bearing supply houses. Teflon is a nylon type plastic, somewhat pliable and slippery. It can be machined like metal and can be worked easily with saws, files and sandpaper.

Vertical rod G has a hole running up through it which intersects a horizontal hole in the yoke to allow the wire leads to pass. To allow greatest possible clearance for the wires and to prevent binding, the wall thickness of this vertical passage is only 1/32 inch. This entire part was machined by the authors on a tool-room lathe, but to simplify machining it may be made from a piece of brass tubing and a machined yoke (H) which can be slipped over the tube and soldered in place. Teflon bushings can be made from stock tubing or rod, and dimensions altered slightly to get a good fit. The collar on part I should be made only about 1/32 inch long and as thin as possible. The hole in Teflon Bearing L should then be machined for a good easy fit. The screws (R) are ground to a point and fit into small holes, about 1/32 inch in diameter, in the yoke (H). Be sure you center these holes properly by marking the yoke after it is in place by tightening the screws up against it. For stereo, or an arm that is to be used with very low tracking pressures, some vertical damping other than pure friction is desirable. This can be provided by drilling 1/8-inch holes in the yoke and plugging them with Teflon rod. Then the plugs are drilled with small holes to accept the pointed ends of bearing screws R. It is then possible to adjust the vertical damping by tightening the screws. The proper amount of damping will allow tracking warped records at very low pressures.

D is a 10-32 screw about 2 inches long threaded to block C. The counterweight can then be adjusted and fixed in position with nut F. Plate A is fastened to the arm with three 6-32 screws with spring mount P placed under the rear screw on the upper side of the arm. After the yoke is inserted and the screws R tightened, spring S is fastened between the top of G and mount P. A 6-32 screw, with a small hole in the end to accept the spring, is fed through a hole in the top of mount P. A nut on either side allows the screw to be fixed in place and maintain the proper spring tension. The spring used was the brush spring from a small, about 1/20 horsepower, electric motor which is readily available, but any small soft spring will do.

The cartridge plate CP can now be mounted, taking care to mount it at the proper offset angle. A slight deviation can be tolerated since most cartridges themselves can be rotated slightly in position before tightening them down to the plate. This operation must, of course, be performed with great care to get the correct offset angle. Lead wires can be inserted and held along the bottom of the arm with spots of glue. These wires are fed through the hole in yoke H and allowed to hang freely down through the hole in rod G. A small shielded wire should be used since flexibility is vital.

With the needle and cartridge in place or approximately positioned, distance L can be measured and mounting distance H or overhang d and offset angle calculated or found from Fig. 2. Mounting plate N is positioned, a hole drilled in the turntable mounting board, and the plate N screwed in place. Shaft K can be adjusted for proper elevation so that the cartridge is horizontal when set on a record. Nut M is then screwed down tight.

Before the arm is tested, it must be balanced and the spring tension set. Remove spring S and move the counterweight and lock nut until the arm is statically balanced. Make sure bearings R allow free movement. Replace the spring and adjust it till the needle exerts the proper force on the record. Norelco and Weathers cartridges have been used for monaural and stereo with needle pressures of from 1 to 4 grams.

Use the minimum force that will still provide good tracking. If the force is too small, flutter or hiss may occur and noticeable distortion may appear in loud passages. Minimum tracking force is dictated by cartridge compliance, assuming the arm works perfectly. The poorer the arm, the greater the tracking force required. Consequently greater deterioration of sounds and the records themselves results. With the arm described, the authors have been able to keep tracking forces to minimum values consistent with cartridge compliance. Vertical bearings R should be adjusted now. They should be only tight enough to prevent groove skipping and flutter on warped stereo records. END

6-inch-meter VOM

(Lafayette TE-900)

CB Checker

(Knight-Kit Ten-2)

A METER WITH A 6-INCH FACE HAS ONE great advantage—you don't have to perch it precariously on the edge of the bench to be able to read the measurements.

The large scale on this 20,000-ohm-per-volt (dc) meter is easy to read even when it is safe on a shelf at the rear of the test bench.

The low voltage (0 to 0.25) range is ideal for transistor circuits. With a between-the-probes-resistance of 5,000 ohms, circuit loading will be noticeable only when the circuit resistance with which it is connected in parallel is much greater than 500 ohms.

The next higher dc voltage ranges of 0 to 1, 2.5 and 10 volts are also useful in transistor circuit measurements.

Ranges of 0 to 50, 250, 1,000 and 5,000 volts will find use in troubleshooting vacuum-tube circuits in radio, hi-fi and TV units.

Current measurements are limited to dc in six ranges (0 to 50 μa, 1 ma, 10 ma, 100 ma, 500 ma and 10 amperes).

All dc measurements are better than $\pm 3\%$ of the full-scale reading.

Ac voltages are better than $\pm 4\%$ at 5,000 ohms per volt. The lowest range is 0 to 2.5; the highest 0 to 5,000. There are six ac voltage ranges.

The three resistance ranges (R $\times$ 1, R $\times$ 100 and R $\times$ 10,000) have 12, 1,200 and 120,000 ohms at center scale.

For the R $\times$ 10,000 measurements a total of 7½ volts is used—higher than the voltage rating of many transistors and components used in transistor circuits. *Be careful!*

There are decibel ranges for audio measurements: -20 to $+50$ db, in four ranges. The frequency response is ± 0.5 db from 10 cycles to 100 kc for the three lowest ranges (2.5, 10 and 50 vac).

Although the function switch has an OFF position, no external power is used in the instrument. The OFF position is labeled TRANSIT on some other meters. In both cases it shorts the sensitive meter

movement to prevent damage to the moving coil when the instrument is carried from place to place. It will also reduce the possibility of internal damage if the meter is dropped.

The 16 pages of the operating manual include measurement techniques, special instructions, warning notes and a full-page schematic of the instrument.

The circuit is more or less standard —similar to that found in just about all vom's.

There are calibration controls to make up for normal changes in the strength of the meter magnet and the aging of the ac rectifier.

Meter magnets lose a little of their magnetism, normally, as time passes. Rough handling will increase the loss. Such things as resting the meter on a power transformer while taking measurements will help demagnetize it. While these causes may seem trivial they can change the calibration of a sensitive movement considerably.—*Elmer C. Carlson.*

Knight-Kit Ten-2

SPECIAL CB TEST INSTRUMENTS ON THE market differ considerably. Some are precision instruments for the licensed service technician; some are designed to aid the CB operator in checking his equipment. Few, if any, are as versatile as Allied Radio's Knight Ten-2 CB Checker. It is a self-contained instrument that helps you in nine ways to get the greatest efficiency and maximum range from your CB rig.

The Ten-2:

1. Checks the impedance match between the transmission line and antenna by measuring the standing-wave ratio.

2. Measures rf power output up to 5 watts.

3. Measures percentage of modulation on both positive and negative modulation peaks.

4. Measures relative radiated field strength to determine the effects of antenna and transmitter adjustments.

5. Checks crystal activity.

6. Serves as an audible and visual signal monitor.

7. Generates a tone-modulated, crystal-controlled rf signal for aligning or servicing the receiver's circuits.

8. Generates an audio signal for testing or signal tracing in the transceiver's audio circuits.

9. Operates as a code practice oscillator.

The field-strength meter and monitor use a basic detector and amplifier circuit. The off-the-air signal is picked up on a whip antenna and developed across a broad-band 27-mc tuned circuit. The signal is rectified and fed to a transistor af amplifier.

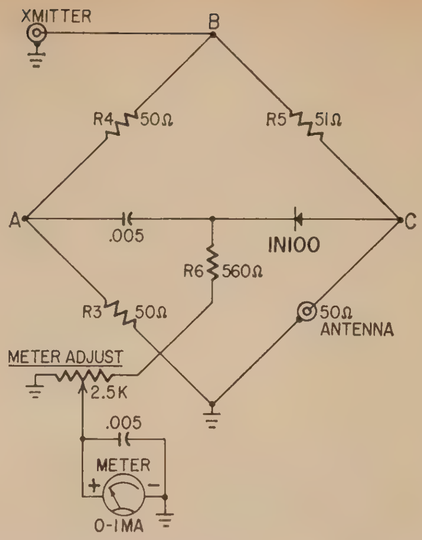
When measuring signal strength, a meter in the collector circuit is part of a bridge. When used as an audible monitor, the af signal is developed across an af inductor in the collector return and fed to a phone jack on the front panel.

The rectified rf signal is tapped off and fed to a jack to which a scope can be connected for observing the modulation envelope.

A Colpitts transistor oscillator checks crystal activity. The meter in the collector circuit is set for full-scale deflection with the crystal plugged in. The meter reading drops when the crystal is removed. The lower the reading, the more active the crystal.

The rf portion of the signal generator is the same as that in the crystal checker. The signal is tone-modulated by a Hartley transistor oscillator using the primary of a center-tapped audio transformer. The rf oscillator's collector current flows through the secondary and is modulated by the audio tone.

When the function selector is in the AUDIO OSC position, the audio oscillator is turned on and the output is taken off at the phone jack. Switching to CODE OSC



Unusual SWR-measuring resistance bridge in Knight Ten-2 CB Checker.

places the key jacks in series with the battery so the oscillator can be keyed for code practice.

Power output is metered by rectifying the unmodulated rf voltage across a built-in 50-ohm dummy load and measuring it on the meter scale calibrated directly in watts.

The modulation meter is used to determine just how loud you must talk and how close to hold the mike for optimum modulation level. The circuit is similar to that used for power output measurements. But in this case the positive or negative peaks of the modulation envelope are rectified and fed to the meter and compared to a preset level determined by the strength of the unmodulated carrier.

The most common standing-wave-ratio bridges in CB test instruments are versions of the Monimatch. The SWR is determined by comparing the forward and reflected voltages on the transmission line. The Ten-2 uses a resistive bridge circuit (shown in the diagram) for SWR measurements.

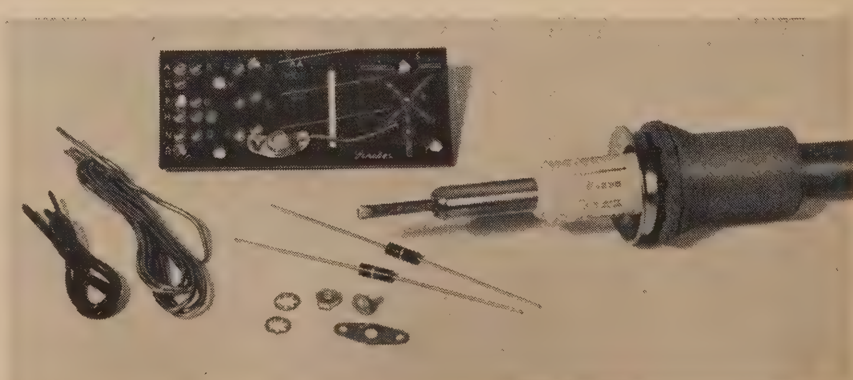
An unmodulated signal from the transmitter is fed into the bridge with the antenna disconnected. The full rf voltage appears between B and ground and between C and ground. Only half the applied voltage appears between A and ground so the bridge is unbalanced. Rectified current flows through R6 and the pot to ground. The METER ADJUST control is set for full-scale deflection.

When the antenna is plugged in, the meter is more nearly balanced and the meter reading drops. If the transmission line and antenna are matched and have an impedance of 50 ohms, they appear as a resistor equal to R3. The bridge is perfectly balanced and A and C are at the same rf potential. No current flows through the meter so it indicates a SWR of 1, an ideal condition.

Novices and other hams running low power on 10 meters will find the Ten-2 a useful tool around the shack. The field-strength meter, monitor and the signal generator functions are particularly applicable. The SWR bridge can be used for antenna adjustments if the transmitter power output is reduced to 5 watts or less.—*Henry O. Maxwell.*

Kit Teaches Most Important Electronic Skill

Kit manufacturers have found that one of the greatest sources of trouble—if not the greatest—is poorly soldered joints. The Schober Organ Corp. supplies each purchaser of an organ kit with the little "How-to-Solder" kit shown in the photograph. A number of good printed circuit soldered connections and one to a soldering lug are shown. An additional soldering lug, solder and a pair of resistors (but not the iron) are supplied so the purchaser can attempt to duplicate the perfect connections. The kit is also used to educate and convince people who would like to build an organ but are afraid that their soldering skill is not great enough.

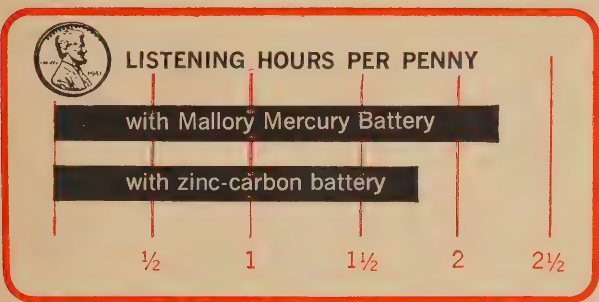


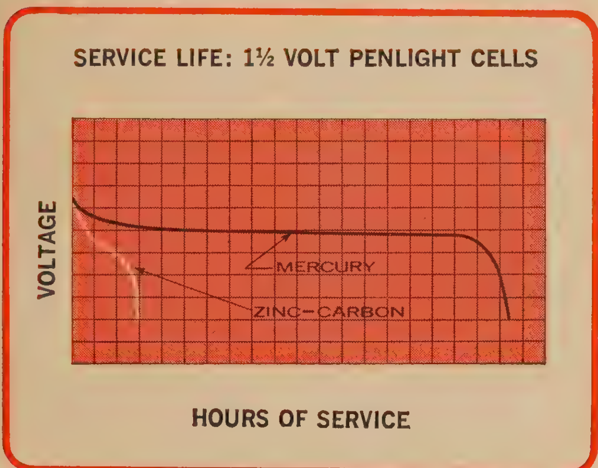
MALLORY

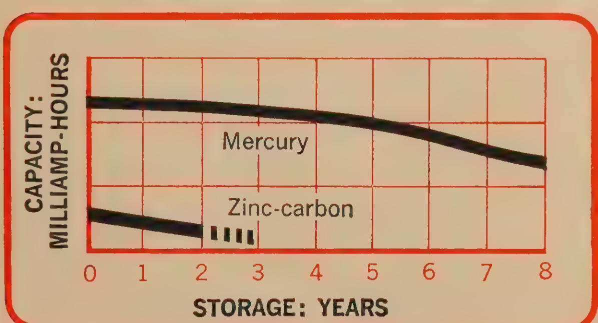
Tips for Technicians

Mallory Distributor Products Company
P.O. Box 1558, Indianapolis 6, Indiana
a division of P. R. Mallory & Co. Inc.

Why Mallory Mercury Batteries work better in transistor radios







There are a lot of good reasons why more and more people are using mercury batteries in their transistor radios. And the reasons boil down to this—they're a better value, and they give better performance.

To get a comparison between mercury batteries and ordinary zinc-carbon batteries, let's look at a typical transistor radio. This radio uses size "AA" penlight batteries and has a current drain of 15 milliamperes. The Mallory Mercury Battery is the ZM9 and the zinc-carbon type would be the NEDA type 815. The ZM9 retails for 75¢ versus 20¢ for the 815. Got the picture?

Here's where the fun begins. The ZM9 will operate the radio for 165 hours versus only 35 hours for the zinc-carbon battery. This means that for one penny you'll get 2.2 hours of listening pleasure using the ZM9 versus 1.75 hours for the zinc-carbon battery. In other words, it costs you 0.57 cents per hour to use the zinc-carbon compared to only 0.45 cents for the mercury battery.

We're not through yet. Let's get back to *listening pleasure*. The mercury battery has essentially a flat discharge curve. This means that it presents a more constant voltage to the transistors. Result: you don't have to keep turning the volume control up while you're listening AND the radio *sounds* better because there's far less distortion.

Had enough? There's one more important point. Suppose you put the batteries in the radio and use it only slightly. Those 20¢ zinc-carbon batteries go "dead" in a few months whether you use them or not. But the mercury batteries can be stored 2 to 3 *years* and still deliver dependable power. Plus the fact that Mallory Mercury Batteries are guaranteed* against leakage in your transistor radio.

We've used this "Tip" to illustrate the superiority of Mallory Mercury Batteries in transistor radios. But this superiority extends to *thousands* of other applications. So whether you're building test equipment, heart-pacers, or satellites, see your Mallory Distributor. He has a Mallory Mercury Battery that will do exactly the job you want done.

**We guarantee to repair the radio and replace the batteries, free of charge, if Mallory Mercury Batteries should ever leak and damage a radio set. Send radio with batteries to Mallory Battery Company, Tarrytown, New York.*

A Binary High-Capacitance Substitutor Box

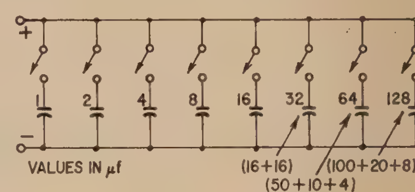
By IRWIN MATH, WA2NDM

THIS BINARY CAPACITOR SUBSTITUTION box will give any value of capacitance between 1 and 255 μf in steps of 1 μf. If a greater range is desired, a 256- and a 512-μf capacitor will extend the range to 1,023 μf.

By paralleling the values, the many combinations of capacitance are obtained with the smallest practical number of capacitors. (The principle works equally well with resistances, of course.)

The entire unit is built in an aluminum Minibox. The odd values of capacitance, such as 128 μf, can be built up by paralleling obtainable values. For example, 100 μf in parallel with 20 and 8 μf gives the 128 μf.

Be sure that the applied voltage does not exceed the rating of your capacitors. Build in a safety factor: If you plan to use this on transistor sets only, with voltages up to 15, use 25-volt capacitors; if for amplifiers up to 400 volts, use capacitors with a 600-working-volt rating.



There is a simple way to determine which switches to throw for a particular value, whenever the values are such that you can't calculate them in your head. Write down the value. Now divide successively by 2, indicating the remainder, if any, by "1," and no remainder by "0." Example: Take 234 μf. Dividing by 2 leaves 117 with no remainder, so we can write down a 0. Divinding 117 by 2 leaves 58 with a remainder of 1, so we write down 1 *to the left* of the 0. Dividing 58 by 2 leaves 29 with no remainder, so we write a 0 to the left of the 1. Again dividing by 2 leaves 14 with a remainder, so we write another 1. We continue doing this until we finally divide 1 by 2. This is not an even division, thus the answer again is a 1. Our final binary number is now 11101010.

Starting from the right wherever there is a zero, we do *not* switch in capacitance; wherever there is a 1, we *do*. Thus we would have: no 1, a 2, no 4, an 8, no 16, a 32, a 64, and a 128, which would give us:

$2+8+32+64+128=234$ μf END

tape recorders
(Ampex F44 series)
and
a wireless remote-control fm/stereo tuner
(Fisher MF-320)

THE AMPEX F44 SERIES OF TAPE RECORDERS are improved lineal descendants of the earlier 900 and 1200 series. Materials, precision and craftsmanship are up to the almost unique Ampex standard. A single motor drives the capstan and both reels, through a surprisingly simple transmission and mechanical linkage. The tape mechanism is mounted on a die-cast base, and there is a minimum of stamped metal parts.

All this pays off in superb smoothness. The F-4460 starts fast and stops fast in fast-forward, reverse, and operate.

It is virtually impossible to foul it up except by actually trying to, and even then I managed it only once, with no damage to the tape.

The transport is superior to some past models in being absolutely silent. Unless a warped reel is used and the tape rubs against the rim, there is no noise during recording, playback or standby.

As in previous Ampex models, the recording mode can be actuated with one hand, by putting a thumb on the record button and the fingers on the adjacent operate lever. This is a great convenience, particularly when editing and dubbing with another recorder or tape deck. As a safety measure, to prevent depressing the record button accidentally, it is necessary to push the operate lever slightly counterclockwise before the record button will go down.

Speaking of editing: with the cover off the heads, the most delicate cutting and editing can be done since the playback head is fully exposed and it is possible to spot and mark the exact portions to be cut. Once the trick of taking off the cover is mastered, it can be done in a few seconds, with fingers only. A gear-driven digital counter provides consistently accurate indexing.

This is, of course, a three-head recorder with separate erase, record and playback heads. Either the input or the tape output can be monitored and the two can be compared immediately. Each channel has a recording level meter and the two scales are adjacent—in fact, the needles scarcely miss each other at the peaks of their trajectories. Thus the two channels can be monitored without turning eyes or head, and you can balance channels at just about any point in the dynamic range without any guesswork.

Stereo or multiple-track or "sound-on-sound" monophonic recordings can be made or played back. There is a low-level mike input and a high-level input on each channel. The separate level controls for each input on each channel are

SPECIFICATIONS AMPEX 4460
(All specifications are the manufacturer's)

Overall frequency response (record & play): 50–15,000 cycles ±2 db at 7½ ips; 50–10,000 cycles +2, −4 db at 3¾ ips
Signal-to-noise ratio: better than 53 db at 7½ ips; better than 48 db at 3¾ ips
Flutter and wow: Under 0.12% rms at 3¾ ips (measured under ASA Standard Z57.1-1954)
Timing accuracy: 1.0%
Recording inputs: 2 high-impedance line inputs, 500,000 ohms; approx 0.15 v rms for max. recording level; 2 high-impedance mike inputs, 2.2 megohms; approx. 0.5 mv for max recording level
Playback outputs: approx. 1 v rms from cathode follower at normal tape levels
Records: 4-track mono, 4-track stereo
Plays: 4-track stereo, 4-track mono; half-track mono, full-track mono
Price: $595.00

of the coaxial clutch type so that once each control is adjusted for the desired balance, the recording level can be changed on both channels together without changing the balance between them.

The output level can also be controlled through individual level controls, also mounted coaxially with a friction clutch. So, once the desired balance is adjusted, the output level of both channels can be changed by turning one knob only. All these work smoothly.

The electronics uses tried and proved vacuum-tube circuits, and is mounted in two thoroughly shielded subchassis at right angles to each other.

As usual for Ampex, specifications are conservative. Response at 7½ ips is stated as 50 to 15,000 and at 3¾ ips as 50 to 10,000 cycles. Actually, with the best tapes, the high-end response is well beyond that. The noise level is one of the lowest in four-track recorders, and wow and flutter are quite inconsequential. Amplifier gain is sufficient for using high-quality dynamic microphones without degrading the signal-to-noise ratio.

The F-44 series is available in models with or without playback power amplifiers and speakers. The model I tested, the F-4460, was without these and is the most compact. I used it for a couple of months for a variety of recording, including recording a musical show in stereo during an actual performance. It is compact for a professional quality recorder, easy to set up and very convenient to operate even in the dark. It always produced superb recordings without failure or problems.

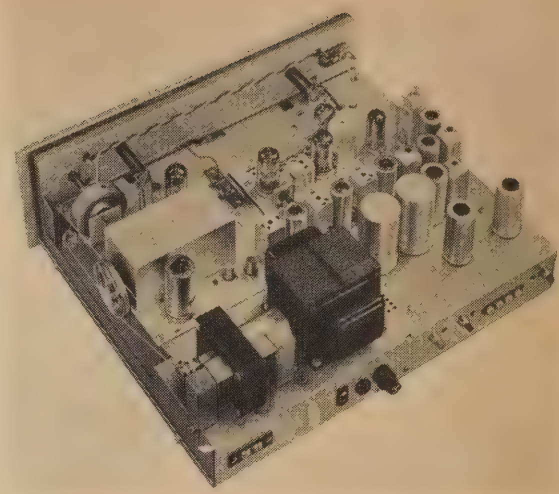
Finally, it is extremely handsome in a regally dignified way. My reaction can be summarized in the simple statement (which applies equally to a Rolls): "I wish I could afford to own one."—*Joseph Marshall*

Fisher MF-320

THE FISHER MF-320 IS THE ONLY TUNER I ever had to learn to drive. This is not to disparage the tuner, a beautifully designed, handsomely executed piece, in the upper luxury class. The tuner is basically a Fisher FM-200-B, the top-number-but-one, with a cascode rf stage and nuvistor mixer and oscillator. Five 10.7-mc stages, all amplifiers for weak signals, but which saturate progressively, last one first, on stronger signals. This give you two i.f.'s and, with the dual-diode dynamic limiter, four limiters on ordinarily strong signals. And that doesn't count the ratio detector, itself an amplitude limiter.

There are no radical advances in the design of the receiving portion of the tuner. The circuitry is complex, a good deal more so than other makes, but apparently the extra effort pays off.

It's hardly necessary to comment on performance—because it meets the standards most people expect from Fisher. Sensitivity, noise limiting, afc action, audio quality, stereo separation are excellent—the tuner matches or outperforms another unit of similar specifications.



The noteworthy delight is in the wireless remote-control system. The MF-320 mates the MF-300 "FM Motor Tuner" to the RK-20 wireless remote control, here built into one cabinet but still on separate chassis.

Superficially, the MF-300 (that's the nonwireless model) looks like any other Fisher tuner, except for two red pushbuttons centered below the dial on the front panel. Push the right one, and the tuning-dial pointer glides to the right, accompanied by a soft whirring. Punch the button and release it instantly: the pointer stops with a click at the first station strong enough to actuate the circuitry. At the same time, a red indicator at the right of the dial scale lights. A second later, the sound from that station emerges smoothly out of complete silence, perfectly tuned and centered in the i.f. passband. If the station is broadcasting stereo, a double red light at the left of the dial winks on and the audio circuitry switches automatically into the stereo mode. The stereo–mono switching is done by a silent diode network, not a relay; less chance for failure.

Punch the same button again (or the other one) and the pointer picks up and moves on, stopping at the next station. If you hold either button in, the pointer keeps going, reversing itself automatically at either end. As it passes each station, the station indicator flashes. Release the button and the mechanism stops at the next station. The buttons are duplicated in a wired remote-control accessory, connected to the tuner by a long cable.

And now, without wires . . .

With the wireless control (either the MF-300 + RK-20, or the MF-320) you can do exactly the same things, but you can also raise or lower the volume and turn your entire system on or off, without touching any of it. The control unit is a tiny plastic box, smaller than a pack of cigarettes, with two pushbuttons. One is marked TUNE and the other, VOL. Pushing the TUNE button and tilting the box to the right sends the dial pointer to the right; pushing the button and tilting left makes the pointer go left.

SPECIFICATIONS FISHER MF-320

(All specifications are the manufacturer's)

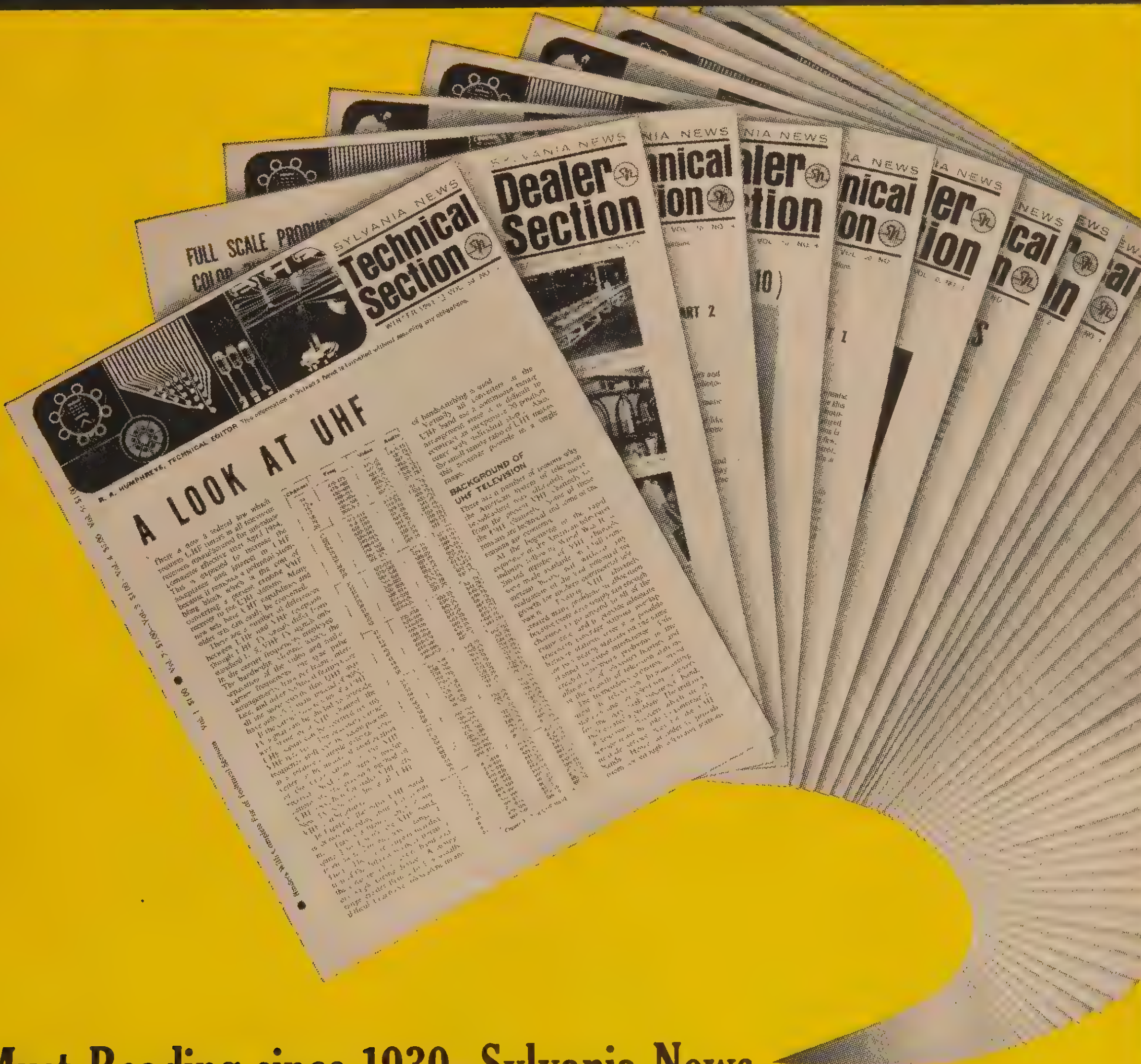
Usable sensitivity (IHF standard)	1.6 µv
Signal-to-noise ratio (100% modulation)	70 db
Selectivity (alternate channel)	65 db
FM harmonic distortion (400 cycles, 100% modulation)	less than 0.4%
Capture ratio	1.5 db
Calibration accuracy	0.2%
Maximum drift (without afc)	.02%
Audio-frequency response	20–15,000 cycles ±1 db
Stereo separation (at 1 kc)	35 db
Rated output	2 volts
Output impedance	100 ohms
Total audio harmonic distortion (at rated output)	less than 0.15%
Audio hum (below rated output)	more than 76 db
Power consumption (at 105–120 volts, 50–60 cps)	58 watts
Price:	$513.95

As before, you can hold the button in or just punch and release, depending on whether you want to hop from station to station or cover a longer stretch.

The VOL button works the same way: push and tilt right, raise; push and tilt left, lower. The on–off switch is mechanically ganged to the volume control shaft so that initially you can push the VOL button on the remote-control unit, tilt the unit to the right and turn the tuner on. An ac convenience outlet on the tuner's rear chassis apron connects other hi-fi components up to the 300-watt switch limit and turns them on and off with the tuner.

The remote volume control is an ordinary ganged pot, driven by a motor, so you can have the entire range of volume from zero to maximum, not in steps but continuously. A tiny lamp behind the panel, fastened to the control shaft, rotates with it and shines successively through a ring of red-jeweled holes around the volume knob. You can tell at a glance, from across the room, the position of the control.

you get PRODUCT PLUS *from your Sylvania Distributor*



Must-Reading since 1930—Sylvania News

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When you rotate the control (manually or wireless-ly) to the off position, the indicator shines green, showing that the tuner is off and the remote control receiver on standby. A separate push-push switch turns the remote receiver on and off; normally you'd leave it on (it consumes very little power) to receive "commands" at any time.

The remote-control system is acoustic; that is, the signal is an ultrasonic "carrier" around 40 kc. The exact frequency depends on what the system is being called on to do—that is, on what button you push and which way you tilt the unit. The tone is generated by a single-transistor oscillator, powered by a 4.2-volt mercury battery. The transducer is a tiny electrostatic device. The remote unit consumes no power except when a button is actually pushed, so the battery life is more than a year.

The receiver is a tiny microphone followed by a three-transistor amplifier module. Amplifier output is routed to two tuned circuits, one at 38.285 kc (tuning), the other at 41.805 kc (volume, on–off). One tone or the other actuates the proper relay for the correct function—regardless of direction.

Tilting the remote-control box to the left actuates a mercury switch and modulates whatever tone is being produced with a 250-cycle "buzz," detected by a third channel. This throws the reverse relay and reverses the tuning or volume motor.

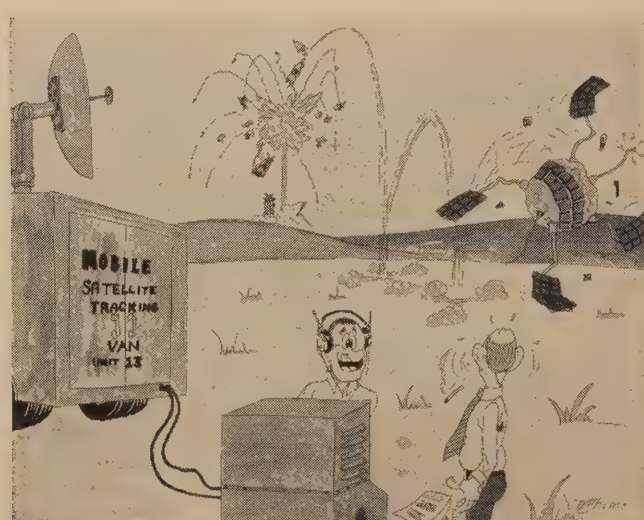
The motor is controlled by a separate 10.7-mc channel that detects the center of channel, and switches the motor off just in time. The last i.f. stage is cut off during this operation, so you hear no sound. When the motor stops, the muting bias disappears—smoothly—and the signal passes through. The afc takes hold and corrects for any mistuning. Two degrees of afc (or none) are available via a front-panel switch, but I wasn't able to detect any practical difference between the two afc-on positions.

There is no tuning meter—no need for one, as long as you're content to let the electronics do all the work. But if you want to disable the afc and the muting (also controlled from the front panel) and go a-hunting for weak stations, you'll miss that meter. Another little annoyance for manual tuning is that the station indicator-light relay always operates, clicking and flashing the light as you tune near the center of each station. If this weren't so abrupt, it might serve as a crude tuning indicator, but as it is it makes finding the exact center of channel more difficult.

The remotely controlled volume control is electrically independent of the tuner, which has its own level-set controls in back. You can control your entire system's volume by connecting the volume control between preamp and power amplifier, or by using the recorder output and tape monitor input jacks, if your combined amplifier has them. But, because of the 250,000-ohm resistance of the volume control, you're limited to using the 3-foot cables supplied.

The polyethylene bag around the entire cabinet is fine—if it is slipped all the way over. In the box I received, it had been bunched and rumpled so that it didn't cover much. The six audio cables were scrunched and tangled loosely, not contained in anything or held together, and one had looped itself around a tube shield inside the cabinet. It needed some maneuvering to get it out. And there were no service manuals —I had to send for them separately.

Still—a good machine, and a fine purchase for the man who has everything.—*Peter E. Sutheim*



". . . Signal is getting stronger!"

New Semiconductors and Tubes

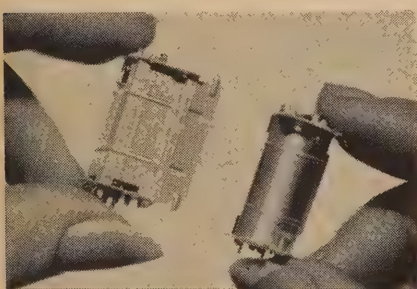
"Customized" compactrons!

A new approach to tube design seems to be emerging from 12-pin compactrons.

General Electric, originator of the scheme, calls it the "building-block concept." It involves standardizing basic tube *sections*—diodes, triodes, pentodes —then combining and sealing them into one "bottle" according to a customer's requirements.

According to W. L. Carl, an entertainment-tube design engineer at G-E, the new idea offers mass-production economy for the small-volume user, permits making a wide variety of space-saving multifunction tubes, and speeds circuit design by keeping standardized sections (like a half 12AX7, a 6EW6, etc.) with which designers are familiar.

While ordinarily a manufacturer who needed, say, 1,000 specially designed tubes for a new product could not expect to fill the need very economically, he might be able to do so with



the new G-E method, as long as his needs were kept to standard sections.

Several "stock" combinations have appeared already: the 6T9, a combined high-μ audio triode and power pentode, described in this column in the March issue. Another is the 6G11, which joins a 6DT6 and a 6CU5. A third is the 6JZ8, which incorporates a single 6SN7 triode and a 6CU5 pentode. (All these are approximate similarities, not identities. There are often many minor differences in capacitances, ratings, etc.) A fourth new compactron announced under this "building block" concept is the 23Z9, which contains a 6SN7-type triode, a 12AV7 triode and a 6CU5.

By standardizing sections in this way, a manufacturer can produce perhaps a million of the standard diode, triode and pentode subassemblies, then link them together in multifunction tubes as required.

Keep those tube charts up to date!

"Line-operated" SCR

A new low-cost silicon controlled rectifier, the 2N3228, is specifically designed and rated to operate directly from a 117-volt ac line.

The device is intended to broaden the uses of SCR's in controlling small appliances and power tools—anything from waffle irons to electric drills. It

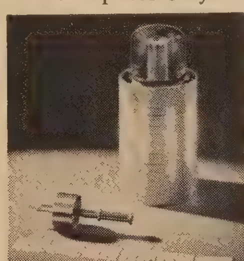
is rated to carry 5 amperes rms at 50°C case temperature. Maximum transient reverse voltage is 330; peak surge current, 60 amps. RCA makes it.

Replaceable-cathode magnetron

A new "Modular Magnetron" for microwave cooking and industrial processing has been announced by Comtek, Inc., Woburn, Mass.

The most startling innovation is its replaceable miniature cathode. Since the cathode is what usually gives out first in almost all tubes, this can extend the magnetron's life greatly. The manufacturer says the cathode "can be replaced for a modest service charge."

The tube requires only 18 watts of



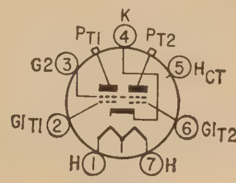
heater power, compared to the 80 to 300 watts used by other comparable commercial types. It measures 5½ inches high by 2½ in diameter, and can be operated at 1 kw input from dc or rectified, unfiltered ac.

6907

This is a new all-glass uhf twin tetrode good up to 600 mc. It is designed for fixed-station and mobile service, as power amplifier, oscillator or frequency tripler for class-C telegraphy, modulated class-C amplifier or class-B audio amplifier or modulator.

As a straight-through rf amplifier

at 150 mc, the 6907 handles 90 watts input with 20 watts total plate dissipation, CCS ratings. The tube can put out 20 watts rf continuously at 600 mc as an unmodulated class-C stage, with a



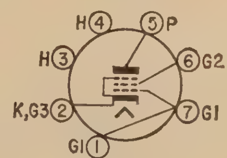
6907

plate voltage of 400 and a screen voltage of 250.

The Tung-Sol 6907's heater is designed for operation on 6.3 or 12.6 volts. The tube can be mounted in any position, and has a standard septar base.

6HG5

A controlled *cathode* warmup time is the feature of this new audio beam power tube for TV sets. The cathode



6HG5

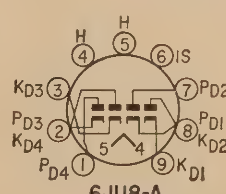
warmup time is specified as 14 seconds minimum, to delay the sound until the picture has appeared.

The 6HG5, from RCA, is in a 7-pin miniature envelope, 2⅝ inches high. With a plate and screen voltage of 250 and a load resistance of 5,000 ohms, the tube produces 4.5 watts audio.

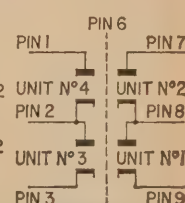
6JU8-A

Not much new about this one—it's just a 6JU8 9-pin miniature quadruple diode in a new envelope, approximately 7⁄16 inch shorter, according to RCA, who announced the new type.

The 6JU8-A, like its older brother, has two pairs of series-connected diodes for use in phase-detector and noise im-



6JU8-A



ARRANGEMENT OF DIODE UNITS

mune color-killer circuits in TV sets, and in bridge matrix and detection circuits in FM stereo multiplex equipment. Units 1 and 2 are shielded internally from units 3 and 4. END

TECHNOTES

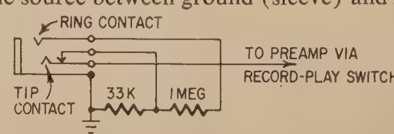
Dead Radio-Phono Input on Norelco "400" EL3536A

If there is no gain on the left radio–phono input, but mike is OK on both channels, and there is a crackling sound as you turn the radio–phono gain control, there is probably a short between R5 (220,000 ohms) and the lug (second from top) that ties C3 (.027 μf). The terminal strip that carries these components is located on the left tube bank (second from the front of the case).

Replace R5 with a 220,000-ohm, 5%, 1-watt resistor and check for noise as you turn the radio–phono gain control. It may be noisy now that there has been B-plus directly across it.—*Steve P. Dow*

Bell & Howell Specialist 900

When you want to record on this unit from a high-level source (recorder outputs on amplifiers, or across speaker voice coils), use a 3-contact plug (Switchcraft 290 or 297). Connect the source between ground (sleeve) and ring contact.

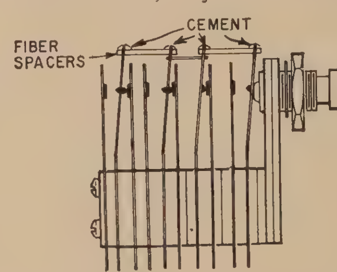


If you must use a 2-contact plug, insert it into the jack just far enough so that its tip touches only the ring contact of the jack.

The schematic shows the wiring for this kind of jack. The tip contact feeds the preamp directly, for low-output sources like microphones. The ring contact feeds the preamp through a voltage divider that gives about 30 db attenuation, to prevent overloading the preamp. The volume control is after the preamp, so turning it down will not cure distortion caused by preamp overload.—*S. P. Dow*

Heath GW-30: T/R Switch

If the fiber spacers on this transceiver's push-to-talk switch come loose and shift, they can make the switch function erratically. A drop of cement on top of the fiber spacers will stop this (see drawing).—*Ronald Blizzard*



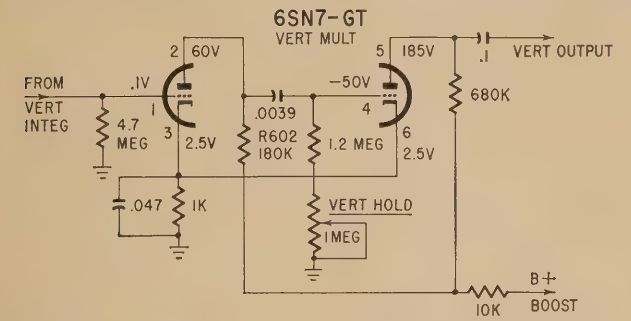
Grundig TK1E Battery Contacts

Take care when you select C-size cells for this recorder. The design of the battery holder requires that you use batteries that do not have recessed bottom plates. Many of the Japanese-made cells have recessed bottoms because of the shape of the side casing seal. This kind of battery can cause

intermittent power connections, because the negative terminal of the cell holder does not protrude far enough.—*S. P. Dow*

Chassis 190: Vertical Jitters

A case of vertical jitters here indicates an unstable vertical oscillator. Check R602 to see if it has changed value—usually to something very low, about 10,000 ohms. If so,



change it, using a 1-watt resistor. A clue to this condition is 300 volts or more on pin 2 of the 6SN7 instead of the usual 60.—*William Porter*

Adjusting Sears Synchroguide

These methods of setting up the synchroguide in Sears sets are usually accurate enough for field service work.

The first way:

1. Short the waveforming coil and its .01-μf capacitor with a short clip lead.

2. Adjust the horizontal oscillator slug until the picture locks in.

3. Remove the shorting wire and adjust the waveforming coil slug until the picture locks in again.

The second way:

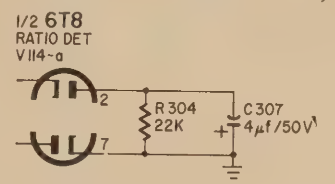
1. Adjust the waveforming coil (usually counterclockwise) until the picture falls out of sync and folds over 5 times.

2. Adjust the horizontal oscillator coil slug until the picture just begins to tear when folded over 5 times.

A few notes: With sets that use a pot as horizontal hold control, set the pot at mid-range. Sears sets that *don't* use a pot for that job have the waveforming coil marked as the horizontal hold control. The capacitor across the coil is almost always .01 μf.—*Lawrence E. Leaman*

Intermittent Hum In G-E U-Series

Intermittent hum in sound has often been traced to a cold-solder and corroded connection of C307, a 4-μf, 50-volt



capacitor to circuit board. Replacing C307, cleaning connections and resoldering will solve this problem.—*K. A. Lloyd*

The Case of the Impossible Vertical Roll

An Emerson 1114 TV provided us with a very unusual service problem. The customer complained of rolling and changing height at a very slow rate. That wasn't so unusual, but he said it happened *only during network shows!* Local programs (all from the same station) were received perfectly. He wasn't crazy; we verified it on the bench.

It didn't take long to figure out that the trouble was 60-cycle line interference with the vertical oscillator or output stage. But where was the hum getting in? All filter capacitors were good and there were no signs of excessive hum any-

where except in the vertical circuits. Heater–cathode short? That possibility was dismissed after the tubes were checked.

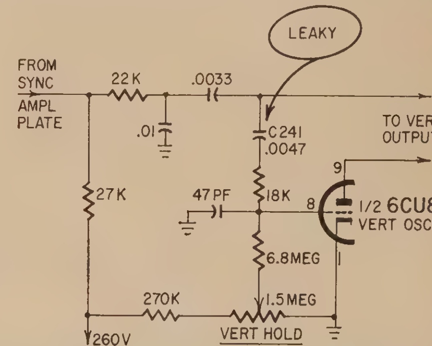
Finally, we isolated the problem in the vertical output stage with the hum being introduced somewhere between the 12W6's control grid and plate. We found that pin 1 of the 12W6, labeled "no connection" in the tube manual, was being used as a tie point for the grid lead from the vertical oscillator output. Apparently some internal tube structure coupled pin 1 to the heater, inducing hum into the circuit.

But why did the picture roll only on network shows? Local shows were synchronized to the same ac line that powered the set. Therefore, the interfering hum voltage had exactly the same frequency and phase as the vertical sweep. Network shows, originating in another city, had a slightly different frequency, and the resulting beat showed up as slow vertical roll and height change.—*George R. Wisner*

RCA KCS-111 — D: Vertical Roll

Sets in this series seem to want to roll vertically after a half hour's warmup. The roll can't be corrected by adjusting the vertical hold control.

Putting a hot soldering iron tip near various parts in

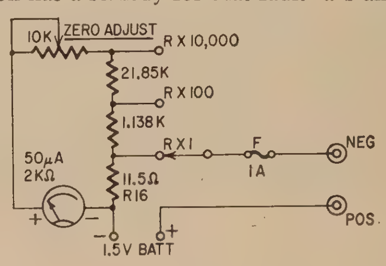


the vertical oscillator circuit showed that heating C241 (see diagram) started the picture tumbling. The capacitor turned out to be leaky. Replacing it cured everything.—*Paul Galluzzi*

Fusing Simpson 260 Vom

I have repaired many Simpson meters in which R16 had burned out (see diagram).

Simpson has a remedy for that fault—a 1-amp 3AG pig-



tail fuse in the negative lead of the meter. If the meter is set on a resistance scale and the leads connected to a voltage over 10, the fuse blows, saving the R16 and the other resistance scales. Try it.—*J. B. Carlisle*

Give the Recorder Air!

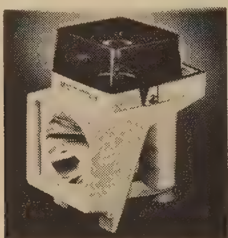
Many tape recorder users put cloths under their machines to protect the surface the recorder is sitting on. Works, but the cloth is often drawn across the air intake vent in the bottom of the recorder's case by the suction of the cooling fan. This causes the machine to overheat.

A host of mechanical and electrical failures have come from this practice—rubber belts break and stretch, bearings sieze and capacitors fail.

Advise your customers—and yourself—to use only a rigid surface under the recorder, one that maintains enough clearance under the machine to let air in.—*S. P. Dow* END

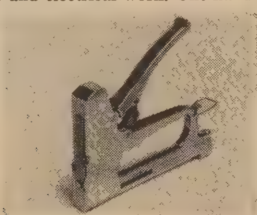
new Products

LANTERN, *Guardsman* for emergency lighting. Rotating warning beacon in red, blue or amber. 500-foot lantern beam on front tilts up or down. Beacon and beam operate together or independently, pistol grip. Swing-up handle, anchoring



suction cup. Manganese batteries. Less than 2 lb. 4 x 6 x 7⅝ in. With 25-ft cord can operate from 12-volt auto lighter socket.—**Mallory Distributor Products Co.,** Indianapolis, Ind. 46206

WIRE TACKER, *model TO-21,* for telephone, electronic and electrical work. One-hand operation,

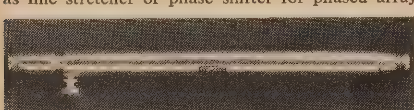


front and rear wire guides for loading ⅜- or ½-in. long staples.—**Heller Roberts Instruments Corp.,** Heller Industrial Fastener Div., 700 Jamaica Ave., Brooklyn 8, N.Y.

FUSEHOLDER, *Buss HLF,* 1⅝ in. long, extends 29/32 in. behind panel. Takes ¼ x 1¼ in.

fuses by changing screw type knob.—**Bussmann Mfg. Div.,** McGraw Edison Co., St. Louis, Mo. 63107

50-OHM CONSTANT IMPEDANCE ADJUSTABLE LINE, with TNC connectors at each end. Possible length variation 7 9/16 to 9¾ in. Use as line stretcher or phase shifter for phased array

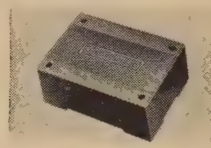


antenna systems, useful in lab at frequencies up to 2.5 gc. Maximum vswr 1.2:1; insertion loss 0.1 db through 600 mc, rf power capacity 100 watts CW. Silver-plated; 5 oz.—**FXR,** Amphenol-Borg Electronics Corp., 33 E. Franklin St., Danbury, Conn.

ANTENNA ROTATOR, *model C-225 Tenna-Rotor.* Transistorized circuitry. Constant synchronization between room control and outside antenna.

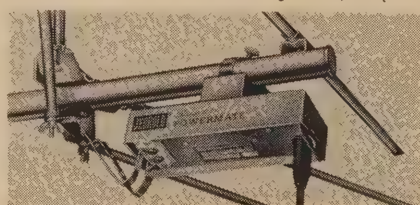
Reversible motor and magnetic brakes. Resembles desk clock; brown and white plastic.—**Alliance Mfg. Co. Inc.,** Dept. MJ, Alliance, Ohio.

MAST-MOUNTED UHF TV AMPLIFIER, *Able-U2,* 2 transistors. Boosts signal strength on all uhf channels. Used with any uhf TV receiver or converter. For mast-mounting near antenna to boost signal before losses and noise pickup on



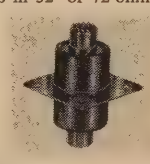
lead-in. Remote power supply unit at 15 volts.—**Blonder-Tongue Laboratories Inc.,** 9 Alling St., Newark, N. J. 07102

TV ANTENNA PREAMP. Coaxial *Super Powermate model SPC-103,* for areas where coaxial lead-in needed to minimize spurious signals or interference and for optimum color installation in semi-fringe and fringe areas. Built-in transformer matches preamp to 75-ohm coax. Metal weatherproof housing mounts on mast or boom. Average gain 14.5 db with maximum output 700,000 μv in



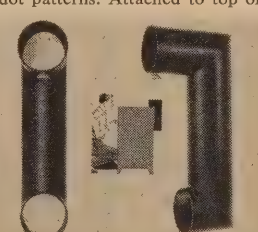
low-band channels, 9.0 db gain with maximum of 200,000 μv in high-band. *Model 103:* remote 117-v ac power supply mounts on back of TV set. 75- and 300-ohm output.—**Jerrold Electronics Corp.,** Distributor Sales Div., 15th & Lehigh Ave., Philadelphia 32, Pa.

AMATEUR AND CB LIGHTNING ARRESTER, *Hy-Gain model LA-1,* reduces static buildup in communications antennas and safely bypasses to ground 10 or more direct lightning strokes. Installs in 52- or 72-ohm coaxial transmis-



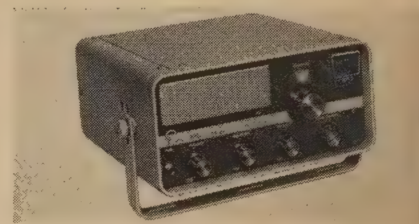
sion lines.—**Hy-Gain Antenna Products Corp.,** N.E. Highway 6 at Stevens Creek, Lincoln, Neb.

STATIC CONVERGENCE adjusted from back of color TV receiver by *Reflect-O-scope.* Reproduces dot patterns. Attached to top of receiver



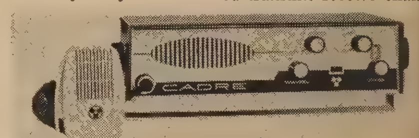
with end fitted snugly against picture-tube face.—**Wallin-Knight Industries,** 3321 McKinley St., N. E., Minneapolis, Minn.

CB TRANSCEIVER, *model FS-23.* Frequency-synthesized receiver and transmitter control. Dual power supply 120 ac at 96 watts or 12 dc at 7.0 amp. 13 tubes, 2 silicon diodes, 1 germanium



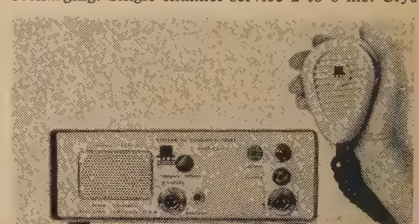
diode and 12 crystals. Power supply: 2 power transistors, 4 silicon rectifiers. Low-noise nuvistor rf amplifier, noise limiter, double conversion. Class-B push-pull modulator. 11¾ x 5¾ x 11¾ in. 15 lb.—**Sonar Radio Corp.,** 73 Wortman Ave., Brooklyn, N. Y.

TRANSCEIVER, *Model 510-A,* 5-watt CB with redesigned audio, power supply, variable tuner circuitry. 5-crystal-controlled transmit–receive chan-



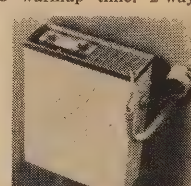
nels and 23-channel crystal correlated tuner, low-impedance push-to-talk ceramic microphone. 3⅛ x 5⅜ x 11⅜ in. Built-in 12 vdc/117 vac power supply. Solid-state circuitry—19 transistors, 8 diodes. Universal mobile mounting kit.—**Cadre Industries Corp.,** 20 Valley St., Endicott, N. Y. 13761

PORTABLE TRANSCEIVER with 200-mile range operates 3 months from car battery without recharging. Single-channel service 2 to 8 mc. Crys-



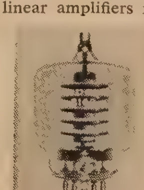
tal-controlled; 15-w nominal input, 12-vdc input. 15 semiconductors.—**Stoner Electronics,** Box 7388, Alta Loma, Calif.

SHIP-TO-SHORE RADIO TELEPHONE, all-transistor *model RAY-1045.* 8 lb., less than ⅓ cubic foot. No warmup time. 2-way range up to



50 miles or more. 45 watts, 6 channels plus BC band. Operates from either outboard or inboard 12-volt systems. 19 transistors, 2 sets of crystals.—**Raytheon Co.,** Lexington 73, Mass.

SINGLE-SIDEBAND TUBE. *No. 8163* zero bias triode for linear amplifiers in single-sideband

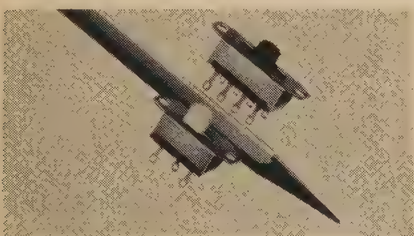


transmitters up to 110 mc; performance level of 666 watts PEP output with 34 watts of feedthrough power. 3rd-order IM distortion 35 db down. 5th-order IM distortion 40 db down. Maximum plate dissipation 400 watts, amplification factor 200. Zirconium-coated graphite anode. Gold-plated pins prevent oxidation.—**Amperex Electronic Corp.,** Tube Div., Hicksville, N. Y. 11802

DC-AC INVERTER. *Satellite, model 50-138-3* operates small portable TV sets or other small electrical equipment, shaver, radio, record player,

etc. Plugs into cigarette lighter or clips to battery of car, boat or plane; needs 110-volt, 60-cycle current. 60 watts continuous, 75 watts intermittent.—**Terado Corp.,** 1068 Raymond Ave., St. Paul, Minn. 55108

SUBMINIATURE SLIDE SWITCHES. Type *G-124:* spdt. 0.812-in. mounting center, 1 in. overall. 0.410 in. wide, 0.33 in. from terminal tip to

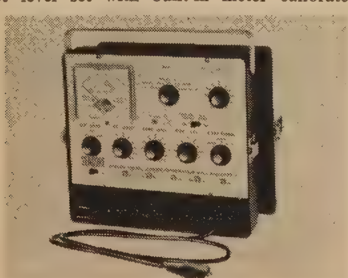


mounting surface. *G-128,* dp3t. 1-in. mounting center, 1.19 in. overall. Both rated 0.5 amp at 125 volts ac–dc.—**Continental-Wirt Electronics Corp.,** 26 W. Queen Lane, Philadelphia, Pa. 19144

BATTERY MERCHANDISER, *model BM12,* contains free Westclox cordless electric clock. 9 x 9 in. Assortment of mercury and manganese batteries for transistor radios, photo and lighting. Self-

inventorying, space for backup stock and cross-reference guide, catalogs, replacement guides, price schedules.—**Mallory Distributor Products Co.,** PO Box 1558, Indianapolis, Ind., 46206

FM MULTIPLEX GENERATOR AND ANALYZER *model MX129.* All FM stereo signals, crystal-control. Left, right channels and 19-kc pilot level set with built-in meter calibrated in



db and p-p volts. FM signal formed with internal 1,000- or 60-cycle note. Jacks for external modulation. Composite signal, modulated or unmodulated. Rf tunable over FM range. 67-kc SCA subscription signal available to modulate FM carrier internally, or externally for 67-kc trap alignment. Less than 1 ft square, 7 lb. 19 transistors, 6 diodes. AC-operated, semiconductors throughout. —**Sencore Inc.,** 426 S. Westgate Dr., Addison, Ill.

TUBE TESTER, *model 628.* Checks emission, shorted and open elements, continuity. 13 lever

50 Years Ago

In Gernsback Publications

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Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Practical Electrics	1921
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some larger libraries still have copies of Modern Electrics and the Electrical Experimenter on file.

In May, 1914, Electrical Experimenter

Design and Construction Details of Radio Antennae, Part II, by H. W. Secor.
Hertzian Wave Collisions, by V. W. D.-B.
A Vibrating A.C. to D.C. Rectifier, by Ralph Hiteshew.
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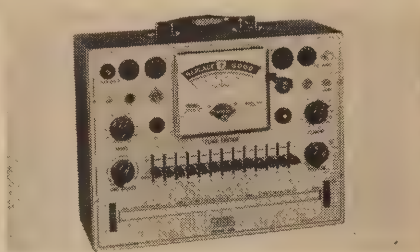
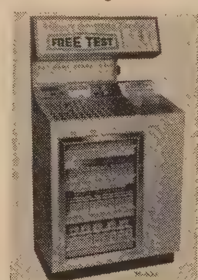
type switches, 4½-in. meter with 3-color REPLACE-WEAK-GOOD scale, 0 to 100 scale for matching. Tests 7-, 9 and 10-pin miniatures, octal, loctal, 5- and 7-pin nuvistors, novars and compactrons, series string, VR's. Color and black-and-white CRT's with optional adapter. 3-column wide



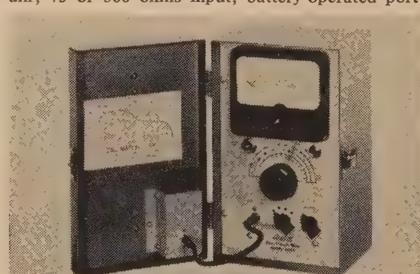
roll chart for extra tube listing capacity. Overload lamp shows transformer overloads, acts as fuse. Filament voltages: 0, .75, 1.4, 2.0, 2.5, 3.3, 5.0, 6.3, 7.5, 12.6, 25, 32, 50, 70, 110. 11 lb. 9½ x 12½ x 4¼ in.—**Eico Electronic Instrument Co. Inc.,** 131-01 39 Ave., Flushing, N. Y. 11352

AUTOMATIC TUBE TESTER, *model 36-800,* tests 7-, 9-, 10-pin miniatures, 5- and 7-pin nuvistors, novars, compactrons, octals, loctals, fuses, panel lights and vibrators. Short and leakage controls adjustable. Detects grid–cathode leakage to 6



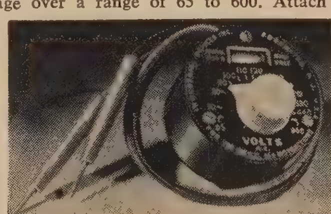
megohms or short between heater and cathode to 500,000 ohms. Leakage and quality test for multi-section tubes.—**GC Electronics Co.,** 400 So. Wyman St., Rockford, Ill.

VHF/UHF FIELD-STRENGTH METER, *model 235A,* reads absolute field strength channels 2 through 83; 10–100,000 µv vhf, 30–50,000 µv uhf; 75 or 300 ohms input; battery-operated port-



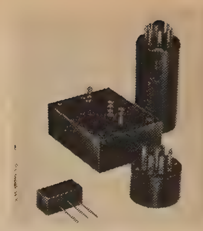
able with headphone jack for audio monitoring. 10½ x 6¼ x 6 in. 8¾ lb.—**Hickok Electrical Instrument Co.,** Cleveland, Ohio

NEON-TYPE VOLTMETER. The *model 400B Mini-Volt* identifies ac and dc lines and measures voltage over a range of 65 to 600. Attach 12-in.



flexible test leads and turn knob until glow lamp goes out. Read voltage off dial. Fully insulated and impact resistant. — **Industrial Devices, Inc.,** 982 River Road, Edgewater, N.J.

WHITE-NOISE MODULES. 4 series; selection of 5-, 25-, 50- and 100-mv bandwidth rms outputs. Frequency ranges 5 cycles to 20 kc, 5 cycles to 100 kc, 20 cycles to 3 mc, 20 cycles to 25 mc, and 20 cycles to 100 mc. In hermetically sealed packages with wire leads, terminals, stand-

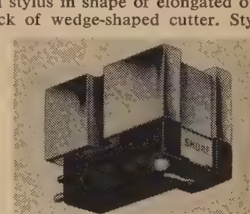


ard octal-socket plug-in bases; or to customer specs. —**Sounvistor Labs,** Solitron Devices Inc., 500 Livingston St., Norwood, N. J.

2-KEYBOARD TRANSISTOR ORGAN, kits *GD-232R* (transistor version of Thomas organ), *GDA-232-1* (bench), *GDA-232-4* (variable-repeat percussion unit), *GDA-232-2* (recorded lessons). 10 faithful organ voices. Variable-repeat percussion:

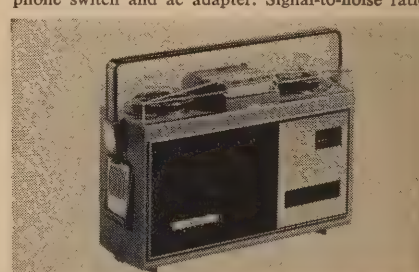
banjo, marimba, mandolin, balalaika effects. 13-note heel-and-toe bass pedals. Expression pedal. Keyboard balance control. 2 overhanging 37-note keyboards. 20-watt peak power amplifier and speaker; transistorized plug-in generators. Factory-assembled, hand-crafted walnut cabinet. 35½ x 39¾ x 21½ in.—**Heath Co.,** Benton Harbor, Mich.

PHONO CARTRIDGE, *V-15 Stereo Dynetic.* Elliptical stylus in shape of elongated oval that follows track of wedge-shaped cutter. Stylus' frontal



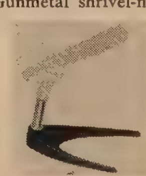
area perpendicular to record groove to minimize tracing distortion and second-harmonic distortion caused by pinch effect. 15° angle. Retracts under excessive pressure to protect record.—**Shure Brothers Inc.,** 222 Hartrey Ave., Evanston, Ill.

PORTABLE TAPE RECORDER. *Norelco Continental 101 EL3586.* 11 x 3¾ x 8 in., 7 lb. Uses D flashlight batteries. Transistor circuit records up to 40 hr per set of batteries. Response 80–8,000 cps. Jacks for headphones, remote microphone switch and ac adapter. Signal-to-noise ratio



better than 45 db. Operates at 1⅞ ips. Motor speed independent of battery voltage. Battery and modulation meter.—**North American Philips Co. Inc.,** High Fidelity Products Div., 100 E. 42 St., New York, N. Y. 10017

DESK STAND, *model DS-14,* for elongated microphones. Gunmetal shrivel-finished base. 3-in.



polished chrome upright ends in standard ⅝ in.—27 thread. Felt pads. 2 lb.—**Atlas Sound,** Div. of

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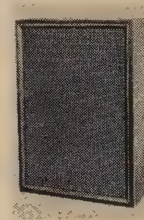
American Trading & Production Corp., 1419-51 39 St., Brooklyn, N. Y. 11218

SPEAKER, *model PA8ECS.* 8 in. speaker 1⅞ in. deep. 3-ounce barium ferrite magnet. Frequency range 40–7,000 cycles. Power rating 15 watts peak.

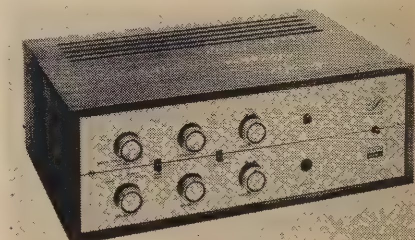
Takes transformers with 1¾-, 2- or 2⅜-in. mounting centers. Diameter 8⅛ in. ¾-in. diam 8-ohm voice coil. 1 lb., 2 oz.—**Utah Electronics Corp.,** 1124 E. Franklin St., Huntington, Ind.

THIN SPEAKER SYSTEM, *Slenderette III,* for remote installations or low-cost stereo or monophonic systems. 6½-in. high-compliance woofer and matched 2½-in. cone tweeter with crossover network. 18 x 12 x 5½-in. walnut-finished cabinet.



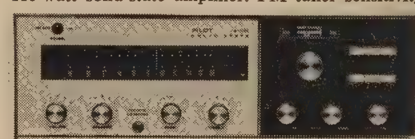
Response 50 to 10,000 cycles, impedance 8 ohms. —**Lafayette Radio,** 111 Jericho Tpke, Syosset, N.Y.

50-WATT STEREO AMPLIFIER, *model 2050.* 50 watts IHF music power, 44 watts continuous power total both channels. Harmonic distortion at 17 watts per channel, 40 cycles, 0.5%; IM distortion at 2 watts per channel level, 0.1%. IHF



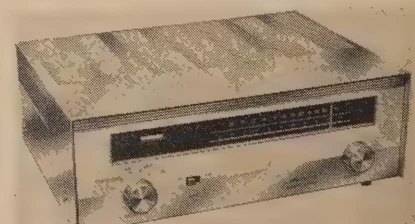
power bandwidth 30 cycles at 20 kc. Stable with any speaker system. 12-db-per-octave HF filter (switched). Speaker-system switch selects between 2 pairs of speakers and headphone jack. 5⅝ x 15⅞ x 11⅝ in., 25 lb.—**Eico Electronic Instrument Co., Inc.,** 131-09 39 Ave., Flushing, N. Y. 11352

AM/FM STEREO RECEIVER, *Model R-1000.* 110-watt solid-state amplifier. FM tuner sensitivity



1.8 μv, capture ratio 1 db. Automatic FM stereo indicator. 4 i.f. stages, front-panel headphone output, harmonic distortion 1%. 6⅛ x 17$^{15}/_{16}$ x 15 in.—**Pilot Radio Corp.,** Yonkers, N. Y.

FM STEREO TUNER, *LT-81C.* Sensitivity, 2 μv for 20-db quieting. Frequency response: 20–20,000 cycles ±2 db. Stereo separation, 30 db at



400 cycles with less than 1% distortion.—**Lafayette Radio Corp.,** 111 Jericho Turnpike, Syosset, N.Y.

All specifications from manufacturers data.

New Literature

booklets · charts · catalogs

NEW AND SURPLUS MERCHANDISE listed in 8-page catalog, including semiconductor bargains; special $1 sales.—**Poly-Paks Co.,** PO Box 942, South Lynnfield, Mass.

BUREAU OF STANDARDS POCKET-SIZE CARD "New Values for Physical Constants." Plastic, 2½ x 3⅝-inch. Includes symbols, values for 19 constants, ranging from speed of light to electron charge-to-mass ratio, plus unit prefixes and conversion factors.—**National Bureau of Standards,** Washington 25, D.C.

CAPSULE THERMISTOR COURSE *No. 5,* "Using Thermistors in Thermal Conductivity Instruments" describes operation of thermistors in "self-heat" mode. Explains how thermistor can indicate, measure or control by changes in thermal conductivity of surrounding medium. Single looseleaf page.—**Fenwal Electronics, Inc.,** Sales Engineering Dept., 63 Fountain St., Framingham, Mass.

MICROMINIATURE TOOLS and clean room accessories described in 32-page catalog. Illustrations and specs, more than 500 listings of microminiature tools, motors, epoxy systems, clean-room uniforms and accessories.—**Techni-Tool Inc.,** 1216 Arch St., Philadelphia, Pa. 19107.

LOUDSPEAKERS. *Catalog 1090,* 16 pages. Complete illustrations and specs for all models, including: electronic musical instrument, circular radiator, miniature, oval radiator, special automotive, drive-in and outdoor, hi-fi replacement, concert-fidelity, intercom, communication and aircraft. Discussion of Syntox ceramic magnet.—**Jensen Manufacturing Co.,** 6601 So. Laramie Ave., Chicago, Ill. 60638.

PRINCIPLES OF RESISTANCE SOLDERING. 16-page booklet explains and illustrates resistance-soldering systems, equipment, advantages, disadvantages and range of application. Request on company letterhead.—**Wassco Glo-Melt Div.,** Customer Service Dept., American Electrical Heater Co., 6110 Cass Ave., Detroit, Mich. 48202.

ELECTRONICS PARTS CATALOG. 1964 Barry's *Greensheet No. 12,* 64 pages. Detailed listings of surplus, industrial, amateur and experimenter components, tools, tubes, hardware.—**Barry Electronics,** 512 Broadway, New York, N.Y. 10012.

SERVICE MANUAL for *Sony Model 500 Sterecorder* available from distributor. 47-page manual in 5 sections: specifications, electronics alignment procedure, mechanical disassembly, mechanical adjustment procedure, and photos, diagrams, parts list.—**Superscope Inc.,** Parts Dept., 8150 Vineland Ave., Sun Valley, Calif. **$2.00.**

INDUSTRIAL ELECTRONICS PRODUCTS *Bulletin No. 641,* 56 pages. Illustrations, list of new products and latest semiconductor directory. —**Allied Electronics,** 100 N. Western Ave., Chicago 80, Ill.

P-N-P EPITAXIAL GERMANIUM MESA TRANSISTORS described in 8-page booklet with specs, characteristic curves and typical application circuits.—**Sylvania Corp.,** 100 Sylvan Rd., Woburn, Mass.

EPOXY SILVER "SOLDERS" AND COATINGS in Information *Bulletin No. 7.* 6-page folder with photos. Comprehensive technical treatment of paste- and pellet-form epoxy "solders" and liquid form epoxy conductive coatings.—**Epoxy Products Inc.,** 133 Coit St., Irvington, N. J.

COMMUNICATIONS PRODUCTS. 8-page brochure describes line of CB two-way radios and accessories, including transceivers, mobile antenna systems, cable assemblies, crystals, noise suppression kits for automotive use. Illustrations.—**Raytheon Co.,** 213 E. Grand Ave., South San Francisco, Calif.

SOLID-ELECTROLYTE HEARING-AID CAPACITORS described in *Engineering Bulletin No. 3515D.* 8-page bulletin on manufacturer's Tantalex capacitors, with specs and curves.—**Sprague Electric Co.,** North Adams, Mass.

COMPACT SPEAKER SYSTEM. Technical fact sheet on new XP-5 compact free-piston speaker system.—**Fisher Radio Corp.,** 21-21 44th Drive, Long Island City 1, N.Y.

RF IMPEDANCE-MATCHING TRANSFORMERS AND BALUNS in 2-color, 4-page illustrated *Technical Bulletin No. C8153.* Standard model specs, with electrical descriptions and mechanical characteristics.—**Trylon Inc.,** Elverson, Pa., 19520.

TRANSISTORIZED SERVO AMPLIFIER. *Data Sheet CE-13.01* describes performance specs on new 7-watt solid-state servo amplifier for industry and lab uses.—**Corning Glass Works,** Electronic Devices Dept., Penndel, Pa.

HIGH-POWER TRIODE, *Type 7242,* described in 4-page bulletin. For use in series-regulated power supplies. Specs, curves and base diagrams.—**Tung-Sol Electric Inc.,** 1 Summer Ave., Newark 4, N. J.

5-WATT CB TRANSCEIVERS. 16-page pocket-sized instruction and operating manual.—**Cadre Industries Corp.,** Endicott, N.Y.

STATIC POWER-CONVERSION EQUIPMENT. 6-page *Bulletin GEA7644.* Shows new line of static inverters and frequency changers. With specs and illustrations.—**General Electric Co.,** Schenectady 5, N.Y.

SOLID ULTRASONIC DELAY LINES described in 12-page booklet, "Glass Memories." Tables and specs on applications, advantages, history, electrical, physical description, and 3 catalog pages.—**Corning Glass Works,** Glass Memories Dept., Bradford, Pa.

SPEAKER, *model 8000.* Grenadier columnar speaker described in 8-page 2-color booklet with illustrations and curves.—**Empire Scientific Corp.,** 845 Stewart Ave., Garden City, N.Y.

KITS in 32-page catalog. Hi-fi, tape recorders, amplifiers, test instruments and ham gear. Photos and specs.—**Eico Electronic Instrument Co. Inc.,** 131-01 39th Ave., Flushing, N.Y. 11352.

LOUDSPEAKERS, compact systems described in 12-page, handsome full-color illustrated booklet. —**Electro-Voice,** Buchanan, Mich.

TAPE RECORDER. 6-page folder about *model RT-360,* which duplicates mono or stereo tapes, monitors, multiple-records. Has amplifier–speaker system. Illustrations and specs.—**Bell Sound Div.,** Thompson Ramo Wooldridge Inc., 6325 Huntley Rd., Columbus 24, Ohio.

GENERAL-PURPOSE CONTROLS. 124-page catalog, *GEC-1260F,* 1964 edition. Pricing, applications, dimensions and weights, features and ratings of general purpose control. Chiefly electromechanical components.—**General Electric Co.,** Schenectady 5, N.Y.

SILICON RECTIFIERS and stacks described in the 1964 *Solidpak* catalog, containing 6 tables of recommended ratings, graphs and specs. 16 pages. —**Solitron Devices Inc.,** 500 Livingston St., Norwood, N.J.

RATIO-ARM BRIDGE, type B-221A, described in 2-color, 4-page bulletin with photos and diagram. B-221A makes 2-, 3- and 4-terminal impedance measurements. Write on your letterhead. —**Wayne Kerr Corp.,** Graham Miller, 1633 Race St., Philadelphia, Pa.

STEREO RECEIVERS, *models 2445-S2* and *2425-S2* are illustrated and described in this 4-page brochure. With specs.—**Bell Sound Div.,** Thompson Ramo Wooldridge Inc., 6325 Huntley Rd., Columbus 24, Ohio.

POCKET-SIZE CIRCULAR SLIDE RULE with instructions. Free when requested on business letterhead. Otherwise **50¢.**—**General Industrial Co.,** 1788J Montrose Ave., Chicago, Ill. 60613. END

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears.

UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

technicians' News

A Striking Tale

A story has been making the rounds of association magazines, under various headings. Seems harmless to repeat it here, for its cheer-up value and the awareness it may bring to the service world of yet one more occupational hazard. Apologies, of course, to those of you who have already seen it in your organization's paper.

Seems a young technician name of Robert Hess, of Kansas City (Kansas? Missouri?), was at a woman's apartment on a callback. As soon as he came inside, she slammed the door, locked it and demanded that the set be fixed.

He began working. Suddenly, the woman grabbed a hammer and landed him a solid one on his right hip. As a tribute to his mettle, he went right on working as soon as the pain subsided, and got the set working. As a tribute to his good sense, he shot out of there in a hurry.

Police were investigating at latest report.

Little Rock TESA Gets New Officers

Newly elected to top posts in the Greater Little Rock (Arkansas) TESA are John Norris, president; Harold Carter, vice president; V. D. Beard, secretary; J. R. McCoy, treasurer, and James Truett, business manager.

Article Guides Set Owners To Honest Service

An article in the December 1963 issue of *Popular Mechanics* may help to curb the growing blanket distrust that many service technicians feel they are encountering from customers.

Titled "How to Find Honest TV Service," the article was written by *Popular Mechanics* electronics editor Larry Steckler, formerly associate editor of Radio-Electronics. He roamed New York City with a set in perfect condition, except for a defective tube. The results were not too rosy: 7 of the 28 shops the author visited were distinctly dishonest in one way or another. That's one in four.

But the article didn't harp on how terrible it is that there are so many crooks in TV service. Half of it was given over to specific recommendations to follow in finding an honest, reliable shop.

Among them was the suggestion that the set owner take the set into the shop himself, and wait while the technician looks at it, on the spot. The owner should watch the man as he works. "Does he seem familiar with the tools he is using?"

Author Steckler suggests that a person looking for repairs pick a shop that belongs to a local technicians' association. While this doesn't prove honesty, he says, there is some recourse in case of trouble later. And be suspicious of *very* low price or free service calls.

Technicians may not agree with all of the suggestions in the article but, for a nontechnical person who needs his set fixed, they are at least reasonable guides to help keep him from getting nicked. He has little else to go by, the first time.

Read the article, and look at your shop with the eyes of a nontechnical customer who has read it also and comes to you for the first time.

Poor Color TV Work May Spoil Sales

The progress of color television is being slowed because many dealers are forfeiting color sales through poor merchandising, reports *TV Digest*. Says Motorola Consumer Products Marketing vice president S. R. Herkes, "We found [in Chicago stores] an unbelievable disregard for sound merchandising of color. . . . Color, a big-ticket product, . . . the most profitable item you handle, is being displayed on many retail floors with no more care and thought than a tiny black-and-white set . . ." He found home installatoins often "hasty and sloppy," negating valuable goodwill and word-of-mouth promotion potential.

The survey showed that in many areas, only a small minority of service technicians had color test gear.

FTC Dismisses Charges Against Washington

Washington—The Federal Trade Commission has reversed a hearing examiner and dismissed, for failure of proof, charges that Westinghouse Electric Corp., Pittsburgh, Pa., has misrepresented its replacement TV picture tubes. The commission had ordered tube companies, Westinghouse among them, to stop calling CRT's with used envelopes " new". (See "FTC Cites 'Undisclosed' Used CRT Bulbs," *Technicians' News*, November, 1963, page 86.)

The FTC also dropped a charge that Westinghouse had given certain dealers the means to mislead the purchasing public about the nature of the tubes.

"Beware the Service Bargain"

You'll never see your doctor advertise a special sale on appendectomies . . .

You'll never see your lawyer announce cut-rates for divorce cases . . . .

You'll never see your dentist hold a "2-for-1" sale on extractions . . .

AND You'll never see the day when you can take your TV set in for a service "bargain" and be sure you're getting a square deal!

"Bargains" in home electronic service are as scarce as the proverbial hen's teeth! Here's why—

The expert service technician, just like other professional people, must undergo years of study and apprenticeship to learn the fundamentals of his skill. And a minimum investment of from $3000 to $6000 per shop technician is required for the necessary equipment to test today's highly complex sets. Finally, through manufacturer's training courses and his own technical journals, he must keep up with changes that are developing as fast as they ever did in medicine, law, or dentistry. Those best equipped to apply modern scientific methods are almost certain to be most economical for you and definitely more satisfactory in the long run.

Unfortunately, as in any business, there will always be a few fly-by-night operators. But patients, clients, and TV set owners who recognize that you get only what you pay for, will never get gypped. "There just ARE no service bargains" . . . but there is GOOD SERVICE awaiting you at FAIR PRICES!

THIS MESSAGE WAS PREPARED BY SPRAGUE PRODUCTS COMPANY,
DISTRIBUTORS' SUPPLY SUBSIDIARY OF SPRAGUE ELECTRIC COMPANY, NORTH ADAMS, MASSACHUSETTS, FOR . . .
YOUR INDEPENDENT TV-RADIO SERVICE DEALER

That phrase will jump out at passers-by when you put this latest Sprague poster in your shop window. Like earlier ones in the same series, this one features an eye-catching cartoon at the top, and some well-written copy explaining why no one should expect a "bargain" in electronic service any more than he would in legal or medical services. The poster is printed in black on a white 17 x 22-inch sheet.

Copies of the poster—as many as you need—are available by writing to Sidney L. Chertok, Sprague Products Co., North Adams, Mass. Association officials might consider ordering enough to pass around at the next meeting.

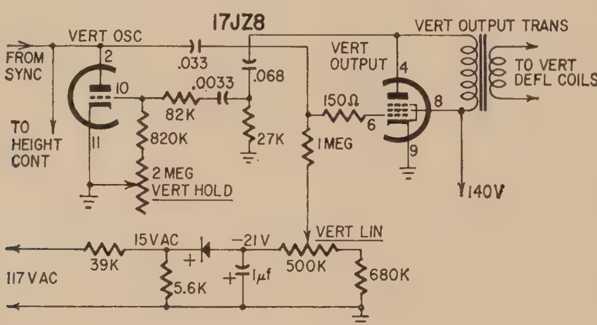
END

noteworthy Circuits

Vertical Sync Stabilizer Circuit

Vertical sweep circuits in TV sets are inherently sensitive to changes in the ac line voltage. Minor changes in line voltage can cause noticeable changes in picture height and linearity. A number of methods of stabilizing vertical height and linearity have been developed in the past. Most modern circuits use one or more varistors (voltage-variable resistors) for this purpose. Some recent Westinghouse sets use a separate bias supply to stabilize the picture against the effects of line-voltage fluctuations. The vertical deflection circuit in the V-2443 and similar chassis is shown in the diagram.

The bias supply delivers a maximum of −21 volts to the output grid through the linearity control. If the line voltage drops—as it often does whenever a toaster or similar high-wattage appliance is turned on—the B-plus voltage drops, the output tube draws less current and the picture tends to shrink. However, the output of the bias supply drops simultaneously. This reduces the bias on the output tube and the plate current increases just enough to compensate for the drop caused by lower plate voltage. Thus, the picture's height and linearity are held constant even during substantial fluctuations in line voltage.—*Henry O. Maxwell*



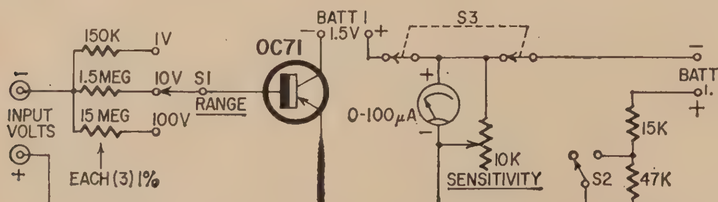
Transistor Voltmeter

When servicing mobile and marine equipment in the field, you may need a voltmeter with greater sensitivity than the usual 20,000-ohms-per-volt vom. A vtvm that requires line voltage for its operation is often useless.

This transistor voltmeter, described by J. Anderson in *The Radio Constructor* (London, England), has a sensitivity of 150,000 ohms per volt and, on the 100-volt range, is more sensitive than the average vtvm.

The voltage to be measured is applied to the base–emitter circuit through a series voltage multiplier. The current in the base–emitter circuit is approximately 6.6 μa. The OC71 has a gain of approximately 40 and the collector current is about 246 μa. The 10,000-ohm control bypasses the excess current around the 100-μa meter. BATT 2 supplies a reverse current that bucks out the residual collector current through the meter when there is no input voltage.

To set up the meter, short the input terminals, open S2 and then zero the meter with the 50,000-ohm pot. If the meter won't zero, return the control to maximum resistance, close S2 and repeat the operation. Set S1 to the 10-volt range, apply a known dc voltage to the input and adjust the SENSITIVITY control so the meter reads correctly. (Mallory RM-400R, TR-152R or TR-146 and equivalent mercury batteries can be used to calibrate the meter at 1.34, 2.5 or 9 volts, respectively.)

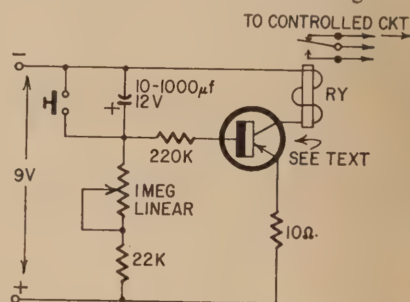


The transistor is a OC71 selected for low leakage current at 1.5 volts. Other p-n-p germanium transistors such as the 2N362 and 2N406 will probably work equally well as long as the leakage current is low at 1.5 volts.

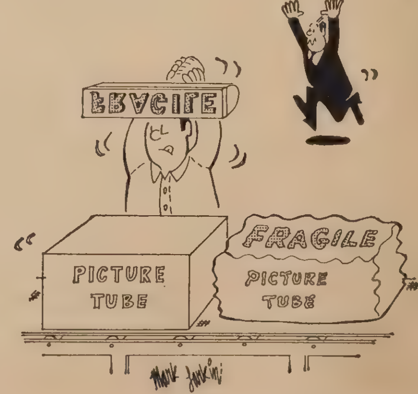
Electronic Timer

This transistor timer circuit can be adapted to cover a wide range of time intervals. When the pushbutton switch is open, the capacitor charges through the potentiometer and series resistor. The transistor's base is then effectively tied to the positive side of the battery through the 200,000-ohm resistor and the relay is open.

When the switch is pressed, the capacitor discharges and the transistor starts to conduct and the relay closes. It remains closed until the charge on the capacitor approaches the supply voltage. The time that the relay stays closed depends on the value of the capacitor and the setting of the 1-megohm pot. With a 25-μf capacitor the time range is approximately 4 to 35 seconds.



The relay is a 300-ohm type that operates at around 8 ma. The transistor in the original circuit, taken from *Revista Espanola de Electronica* (Barcelona, Spain) is the European type OC71. You can use a Mullard OC71 or substitute a 2N109, 2N190, 2N362, 2N406 or equivalent. END

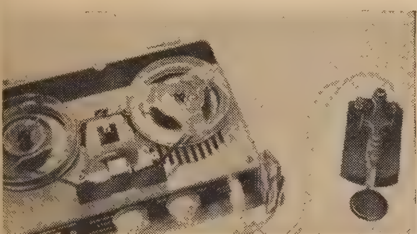


try This one

Code Practice Oscillator Records as You Send

This idea should be most useful in teaching code. It uses one of the inexpensive battery tape recorders now widely available. Connecting a key between the monitor jack and the mike jack produces a tone (when the key is down) that can be recorded directly on the tape.

By inserting a 25-ohm wirewound



pot in series with the motor, you can vary recording and playback speeds to get different pitches and sending rates. With the recorder I used, 40 or more crystal headsets could be driven simultaneously for group instruction.

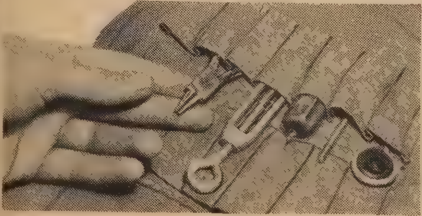
The photo shows the hookup for a Lafayette MS-139 key and a tiny Japanese-made recorder (Apolec RA-11).
—Steve P. Dow

Solvent Aids Soldering

As soon as you take the iron off a freshly soldered joint, paint the joint with lacquer thinner on a tiny brush. The liquid dissolves the rosin and evaporates immediately, leaving a clean joint. Then you can spot a cold-soldered terminal immediately and take care of it.
—L. S. Kroll

Hunting Vest Stops Hunting

TV service technicians—particularly antenna installers—will find a hunting jacket helpful. The cartridge pockets



COMING NEXT MONTH

Control High Power With Transistors

Recondition Old TV's For Better Profits

Five SCR Circuits For Experimenters

Specialized Test Equipment Pays Off in Hi-Fi Service

JUNE RADIO-ELECTRONICS (on sale May 19)

hold standoffs and other hardware. Miniature tubes and tools for servicing mast-mounted boosters fit into those pockets.

Digging for things in your pants pockets when you're perched on a ladder or sitting atop a 50-foot tower is dangerous. Eliminate the danger and save time, too, by using the vest.—*John A. Comstock*

Clamp Holds Light-Shield On Scope Face

Almost every time I used my scope, I had trouble with glare and reflections of room light from the scope face.

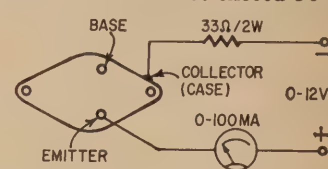
A light shield was the answer, but how to fasten it to the bezel of my Eico 460? The perfect solution was a cable clamp with a screwdriver adjustment from 3 to 6 inches. The one I used is made by The Ideal Corp., 435 Liberty Ave., Brooklyn, N.Y., part no. 5688. Look for it or something similar in hardware, electrical or plumbing supply stores.—*Milton Hollander*

Quick-Checking Power Transistors

To check p-n-p power transistors such as used in auto radios, you need:

(1) 33-ohm 2-watt resistor
(1) 0–100-ma meter
(1) 0–12-volt dc power supply

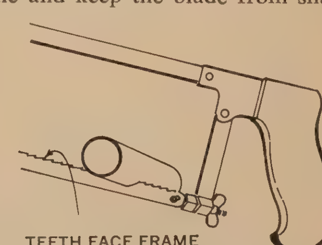
Connect as shown in the diagram. Starting at 0 volts and advancing to 12 volts, the current should not exceed 50 ma at



any time. If it does, the transistor should be discarded. Also, if the current varies after 12 volts has been reached, the transistor is no good. A good transistor will have a steady leakage current of less than 50 ma at 12 volts dc.—*Lawrence E. Leaman*

Sawing Tubing

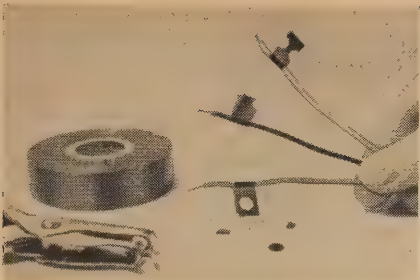
When you have to hacksaw thin-walled tubing or other thin metal, save time and keep the blade from snagging



by inserting it into the hacksaw frame so its teeth point toward the frame. Then saw away!—*S. Clark*

Tape Tabs Mark Wires

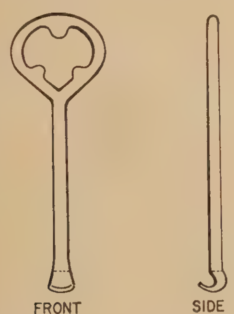
To identify uncoded wires or wires of the same color, put punched tabs of



plastic electrician's tape on each wire. Use a punch code like the one shown or punch marks of different designs.—*John A. Comstock*

Handy Tube Lifters

Paint stores give away paint-can openers which make ideal tools for lifting stubborn tubes out of their sockets.

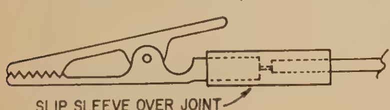


They're shaped just right to give the greatest leverage in the smallest space.

Two of them, one under each side of a tube base, will pry out even the tightest-fitting tubes.—*J. D. Amorose*

Clip-Lead Protectors

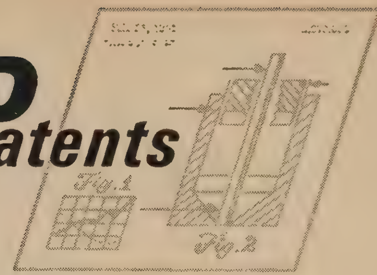
My clip leads break most often at the point where the wire enters the clip. Now I save them by slipping a stiff piece of plastic insulation over the joint



just after soldering. Remember to slide the sleeve over the wire before you solder wire and sleeve together.—*Tom Jaski.* END

'Twenty-seven pins!'

new Patents

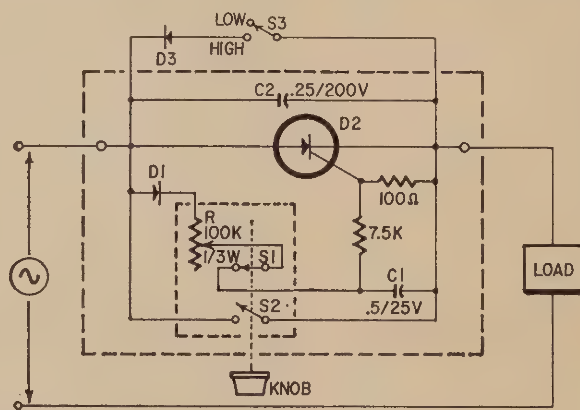


Dimmer Control

PATENT No. 3,103,618

Saul I. Slater, Glen Cove, N.Y. (Assigned to Slater Electric, Inc., Glen Cove, N.Y.)

A small resistor is sufficient to control high power through this silicon controlled rectifier. The SCR (D2) conducts only during positive half cycles, when its gate goes positive also.



A conventional phase shifter, R–C1, determines the length of conducting interval. An important difference is the addition of diode D1. This charges C1, after which the actual firing is controlled by the ripple. R need conduct only this small ac. This phase shifter controls the output over a range of about 2% to 30% of maximum.

For full output, S1 is open and S2 is closed. Reversing these switches cuts off all output. When S3 is closed, the negative half cycles flow into the load, so the total power output may be controlled continuously from about 50% to 80% of maximum.

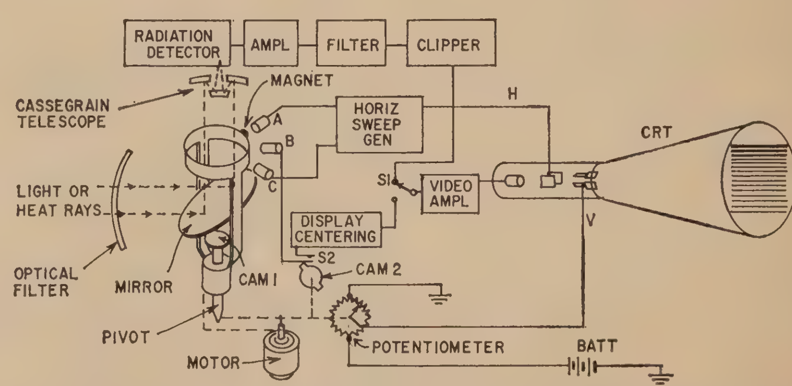
C2 shunts out possible radio interference resulting from pulses through D2.

Remote Optical Search

PATENT No. 3,087,986

Kenneth L. DeBrasse, Fort Wayne, Ind. (Assigned to I.T.T.)

This apparatus detects remote targets by the light or heat they radiate. The energy is intercepted by a mirror mounted on a rotating frame for *horizontal* scanning at 40 times a second. Cam 1 also imparts a nodding motion to the mirror, for simultaneous *vertical* scanning at ½ cycle a second. The energy is reflected through a focusing rotating frame, creates electrical pulses in passing each of three reluctance pickups. Pickup A initiates the horizontal (H) sweep, pickup C terminates it. B, midway between the others, creates a pulse at the instant cam 2 closes S2. At this instant, the cathode-ray tube beam is at the center of its vertical (V) sweep (as determined by the potentiome-



telescope onto a detector. It is amplified, filtered and clipped to eliminate spurious (weak) signals as well as strong signals that could overload. The video information is further amplified (if S1 is in upper position), then fed to an oscilloscope for observation.

A small magnet, mounted on the rim of the ter) and the mirror is midway between the extremes of its vertical scan. This pulse creates a spot which may be centered on the CRT screen (when S1 is in lower position).

This system may be supplied with a radio link to connect the scanning equipment and the display circuits. END

SCHOOL DIRECTORY

new Books

ABC'S OF ELECTRONIC TEST EQUIPMENT, by Donald A. Smith. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 96 pp. Paper, $1.95.*

Basic operation of meters, oscilloscopes, signal generators, etc., for the beginner.

HORIZONTAL SWEEP SERVICING HANDBOOK, by Jack Darr. *Gernsback Library, 154 W. 14 St., New York 11, N.Y. 5½ x 8½ in. 224 pp. $5.75 cloth, $4.10 paper.*

The author, who conducts RADIO-ELECTRONICS' Service Clinic, covers horizontal deflection circuits in his usual thorough, easy-to-read style. Explains the purpose and operation of each section and then shows how to troubleshoot and repair it.

SCOPE WAVEFORM ANALYSIS by Robert G. Middleton. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 160 pp. Paper, $2.95.*

Shows the technician how to read clues displayed on his oscilloscope, for locating defects and making measurements.

A PROGRAMMED COURSE IN BASIC ELECTRICITY, by N.Y. Institute of Technology. *McGraw-Hill Book Co., Inc., 330 W. 42 St., New York, N.Y. 10036. 7 x 10 in., 330 pp. Paper, $6.95.*

A beginner's course in circuits, meters and generators. Covers fundamentals through ac, resonance and Q. Chapters on resistor and capacitor color codes. Arranged in the form of questions to be filled in before answers are disclosed to the reader.

INDUSTRIAL X-RAY HANDBOOK, by Allan Lytel. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 286 pp. Cloth, $7.95.*

A guide to the generation, detection and application of X-rays and gamma rays to medical and industrial uses. Circuit theory and operating principles are discussed.

TELEVISION ENGINEERING (Vol. I, 2nd Edition), by S. W. Amos and D. C. Kirkinshaw. *Iliffe Books, Ltd., London, S.E.1, England. 5 x 8½ in., 297 pp. Cloth, 45s.*

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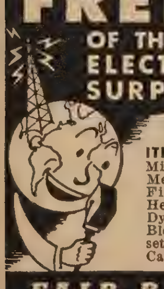

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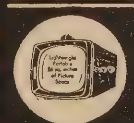

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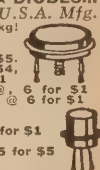

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FOR RENT, airconditioned space formerly occupied Western Union Telegraph Co. Suitable electronic manufacturing plants. Room 508, Franklin, Houston, Texas.

Canadians

GIANT SURPLUS BARGAIN PACKED CATALOGS. Electronics, Hi-Fi, Shortwave, Amateur, Citizens Radio, Rush $1.00 (Refunded), **ETCO,** Box 741, Dept. R. Montreal 1, Can.

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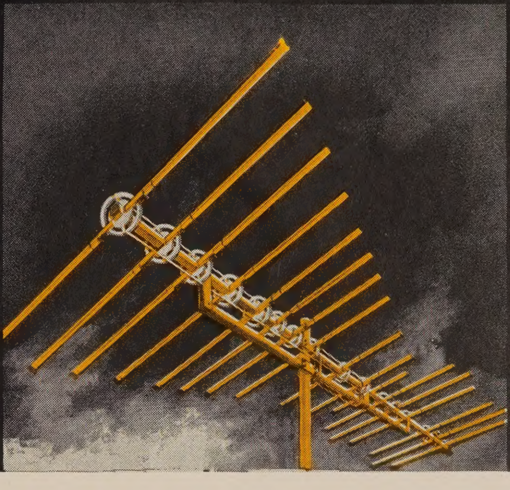
TRANSISTORIZED products dealers catalog, $1. **INTERMARKET,** CPO 1717, Tokyo, Japan.

LIMA, O., SERVICEMEN SWITCH TO JERROLD PARALOG



...they weren't "snowed" by doubletalk!

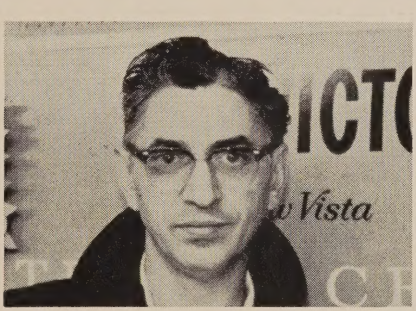
Time and again, throughout the country, it's happening. Wherever we introduce Paralog antennas and ask servicemen to test their performance against competition, Paralog wins new supporters hands-down.

So it went in the difficult Lima (Ohio) reception area when our distributor, Allied Supply, presented the Paralog line to local servicemen. Shown here are a few of the Lima servicemen, previously dealers for other brands, who are now solidly behind the fabulous new Paralog. AND WHY THE SWITCH? Not because of trumped-up "gain charts" or gobbledegook. Simply because they've found that Paralog sells on its performance in all areas.

Have *you* tried the Jerrold-Taco Paralog side-by-side with its competition? Don't—unless you're ready to join the growing army of Paralog boosters.

RAY MAGER, MONTGOMERY WARD

"Paralog works better than any other VHF antenna ever made. We had 200 calls within two weeks. Some of our customers pull in Cleveland, over 160 miles away, consistently."



RALPH DEPALMA, RADIO HOSPITAL

"We insisted on a side-by-side, in-the-air field-strength-meter test. . . . Results proved Paralog superior.... This has been our first big boom in antenna business since the introduction of TV in 1951."

PHILIP NEWLAND, JR., OTIS & CO.

"Our company sold 68% of the color TV in our county in 1962. Obviously we have to use the best antennas, with the best front-to-back rejection. We've switched from Brand C to Paralog."

TOM LAMBERT and FRED ANSEL, VANGUARD ANTENNA SERVICE

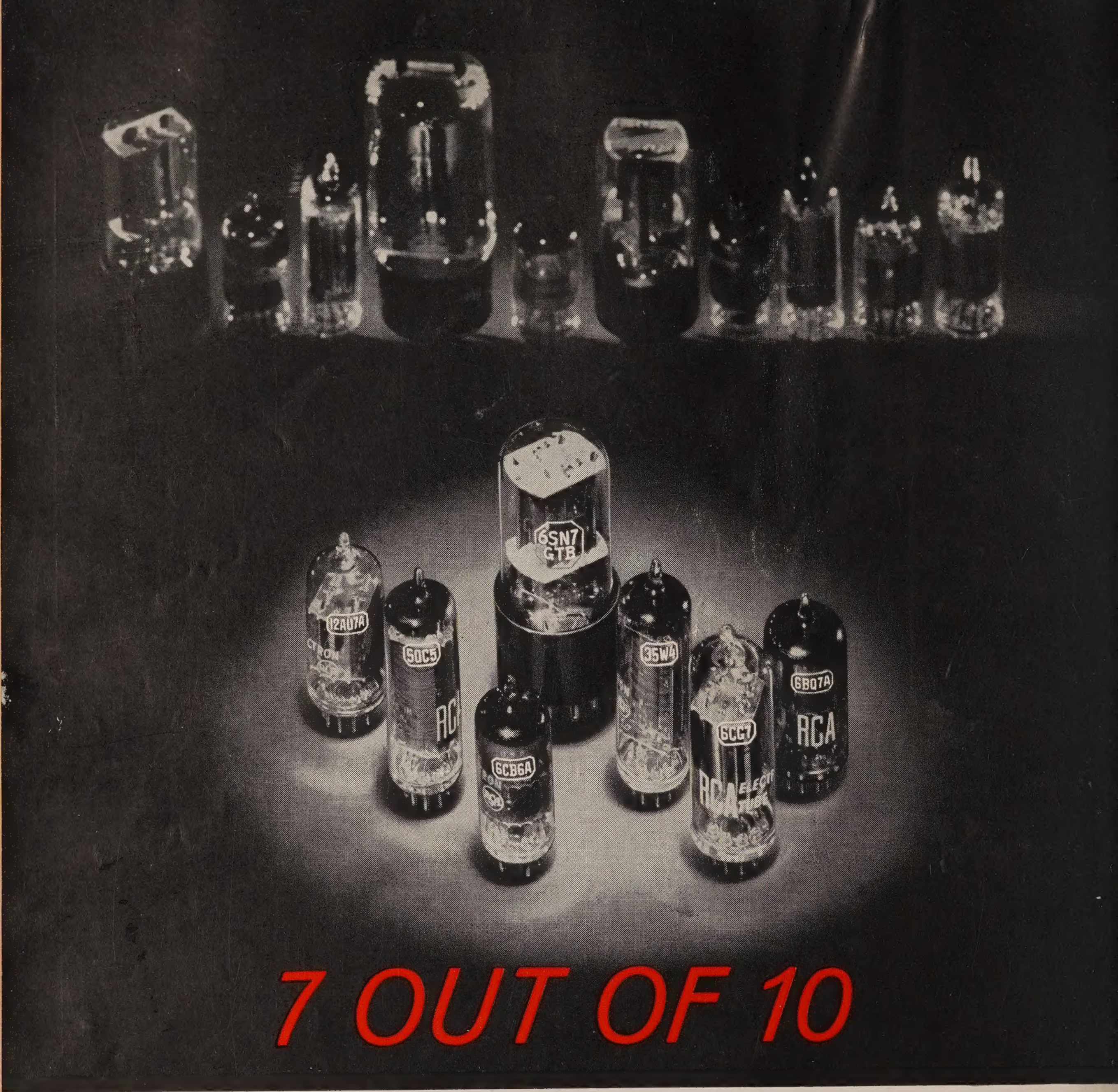
"We've been installing antennas for 13 years. When Paralog hit Lima we found it outperformed Brand C, was built better, and we've been using it 100% ever since."

ROGER HEFNER, HEFNER TV

"As a set dealer who has antenna installations done by an independent installer, the only reception product I insist on is Paralog after seeing its performance in the tough Lima area."

For complete information, write Distributor Sales Division, Jerrold Electronics, Philadelphia, Pa. 19132.

JERROLD ELECTRONICS



7 of the top 10 replacement receiving tube types* were developed by RCA!

This is RCA product leadership at work, creating tubes with great versatility to be used in a wide variety of applications.

As part of its constant search for new heights of tube performance, RCA continues to introduce improvements with new materials and processes. Developments in recent years include *N-132 Cathode Base Material* which offers exceptional uniformity of characteristics and therefore greater reliability; *S-311 Plate Material* which results in very effective heat dissipation; and the revolutionary *Dark Heater* which drastically reduces the chance of heater-associated tube failures. RCA's latest development, *the Bonded Cathode*, virtually eliminates cathode-peeling problems.

When you recommend and use RCA receiving tubes, you identify your business with the industry's product leader, RCA, the brand known for high quality standards and wide acceptance by industry and consumers.

Your authorized RCA distributor is ready to supply you with top-quality receiving tubes, produced by RCA, the Most Trusted Name in Electronics.

**EIA report of industry replacement sales for first 9 months, 1963*

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N. J.

The Most Trusted Name in Electronics